MODERN PLASTICS

JULY 1954

How to Use Color in Plastics ... Page 69

Metal Molds Can Save You Money ... Page 93

29 PARTS

with partial use of Durez

9 PARTS

with full use of Durez

Too many parts in your products?

Could be — in the light of new developments in Durez phenolic plastics.

Yet cutting down on parts is often only the kick-off benefit of product development with these materials. Others can be lower material costs, lower production costs, reduced shipping weight, less breakage or damage in handling, better service in use, improved appearance, and greater sales appeal.

Known with good reason as the work-horse of the engineering plastics, phenolics have been the specialty of Durez for more than three decades . . . we are exceptionally qualified to counsel with your design engineers and molders in applying them most profitably to your business.

Molex Products Co. hit the jackpot in eliminating parts by redesigning this Morton's salt tablet dispenser. Could you do as well — in this or other benefits of modern phenolics application? We'd like to help you find out.

Durez Plastics & Chemicals, Inc., 1207 Walck Rd., N. Tonawanda, N. Y.

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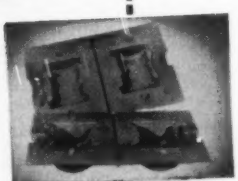
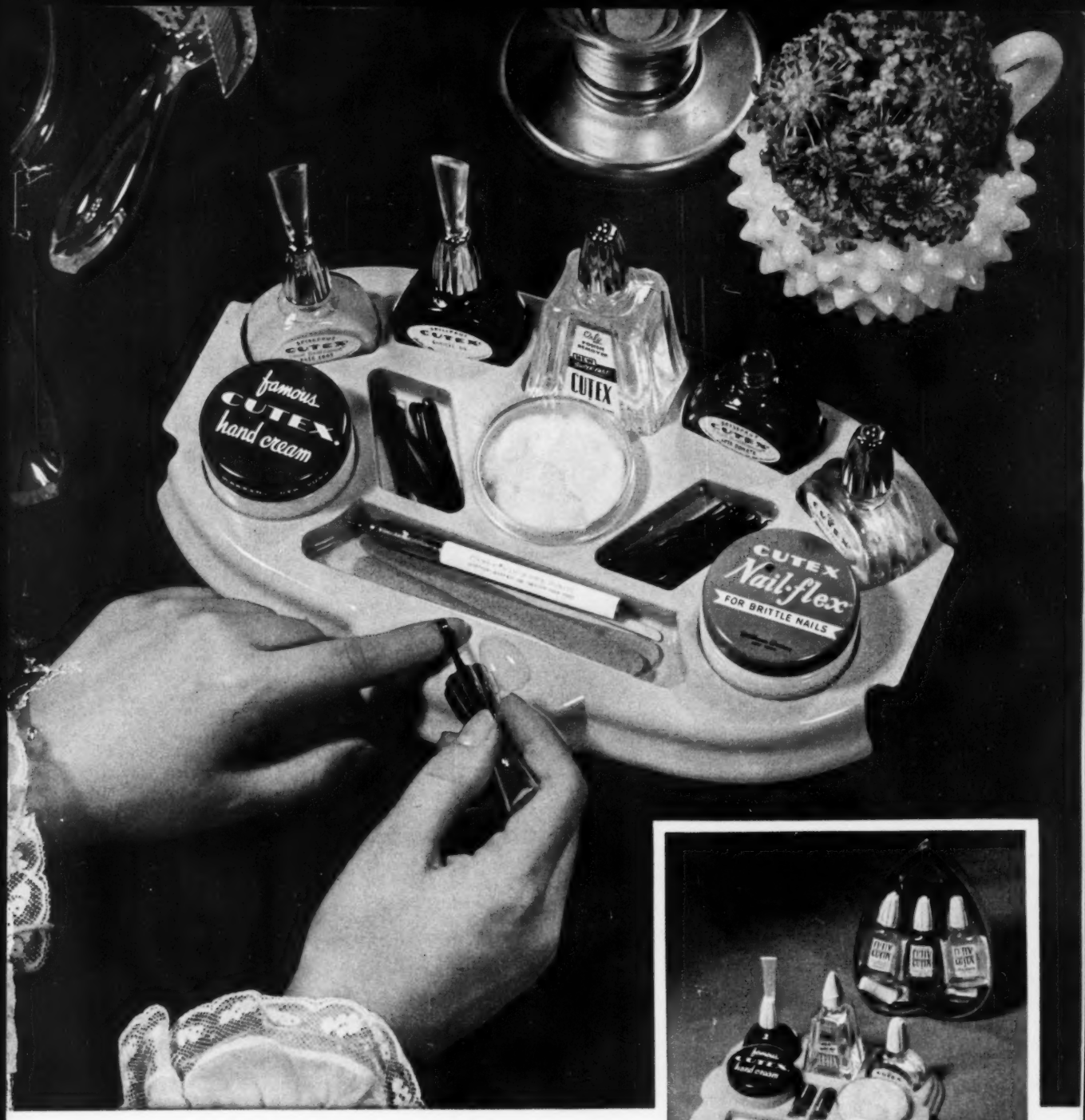
MOLDING COMPOUNDS. Structural, electrical, and chemical properties in many combinations.

PHENOLIC PLASTICS

for the new Competitive Era



RESINS FOR INDUSTRY. Bonding, casting, coating, laminating, impregnating, and shell molding.



CATALIN *Styrene* molds the way!

The maker-marketer of CUTEX* products assigns the gem of plastics to an important role in its holiday merchandising strategy!

One sale, according to the company's projected plan, can move practically every popular member of the famous CUTEX family. To accomplish this aim, thoughtfully designed tray-arrangements molded of CATALIN STYRENE serve to enhance, *fittingly* group selected assortments and safely dispense their contents at milady's vanity table. A third presentation combines the beauty and clearness of CATALIN STYRENE in molding the packaged heart-appeal and re-use value of a special gift offering.

In all instances, CATALIN STYRENE brings the many famous CUTEX items together to move as one!

*Custom molded by Berkeley Engineering & Mfg. Co., Berkeley Hts., N. J. for Northam Warren Corp.

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In addition to Styrene Molding Compounds, Catalin chemical products include a wide range of Urea, Phenolic, Cresylic, Resorcinol, Melamine and Styrene Resin formulations.

MODERN PLASTICS*

July 1954 • Vol. 31, No. 11

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Another new development using

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B. F. Goodrich Chemical Company does not make these shoe covers. We supply the Geon paste resin for the coating only.

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YOU MIGHT laugh at yourself the first time you wore these shoe covers, but their purpose at an Oak Ridge Atomic Energy Plant is no laughing matter.

These canvas shoe covers help prevent the spread of radioactive contamination. Workers slip them on over their shoes when entering a contaminated area. They are made of canvas, with the walking surface coated with a plastisol based on Geon paste resin.

They are thoroughly flexible, and the Geon coating gives them a tough, abrasion-proof surface. The cost of these shoe covers is low despite their important use—thanks to Geon! Maybe this unique use for Geon may help you improve or develop more saleable products, for Geon-based plastisols and other Geon materials have helped build sales for many products—such as colorful upholstery, wire insulation, rigid paneling and tubing and many more.

Check with us; we'll help you select the Geon material best suited to your product's requirements. For technical information, please write Dept. GB-6, B. F. Goodrich Chemical Company, Rose Bldg., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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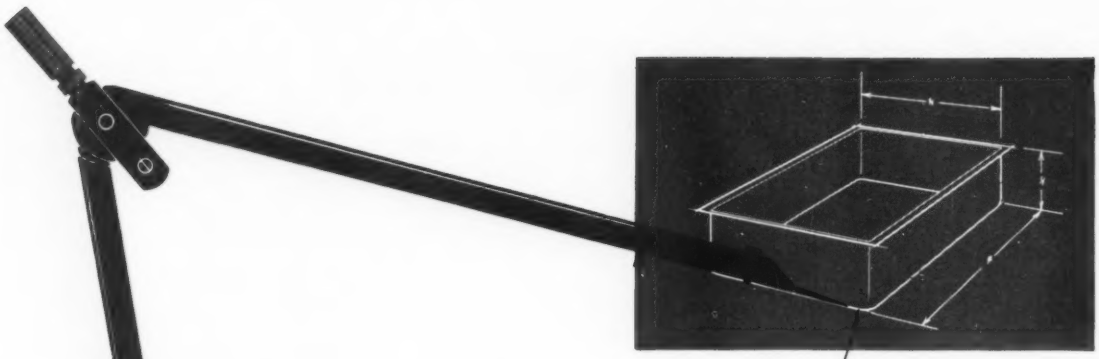

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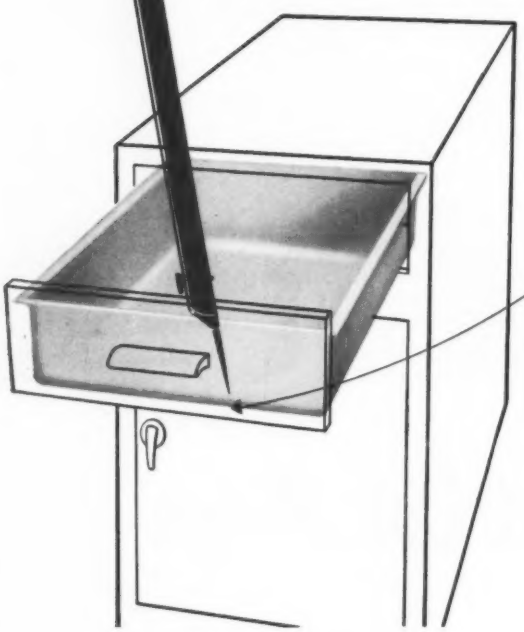

Pilot production mold for drawer shown cost only $25. Mass production metal mold less than $500, and only 3 days to build.

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EDITORIAL

For Better Public Relations

A major problem in plastics' public relations has just now been solved!

It has always been easy to obtain technical speakers for technical conferences on limited phases of plastics and in limited areas of application. It has, up to now, been almost impossible to obtain speakers for Rotary Clubs, Lions Clubs, high school assemblies, women's clubs.

Now, suddenly, anyone in the plastics industry, from the newest stenographer to the chairman of the board, can present an illustrated and highly interesting lecture on plastics to any kind of audience.

The Public Relations Committee of the Society of the Plastics Industry has just completed three full-color slide film strips keyed to three speakers' scripts. One is a 22-min. job for service clubs and business men's groups, entitled "Plastics is *Your* Business." The second is a 27-min. job for high school audiences, "Talking Plastics." The third is a 40-min. presentation for audiences of women, and its title is "At Home With Plastics."

Months of intense work went into the preparation of script, selection of color photographs, and creation of sketches to the end that these film strips and scripts might be practical in use and professional in aspect.

The cooperation of all companies in the industry was wonderful. With over half a million dollars worth of color photography involved, there isn't in any one of these three projects a single plug for a material brand name, a product, or a company.

The slide film strips and scripts will be available at a relatively nominal cost to any employee of a member company of S.P.I. The strips may be used on standard projection equipment available in any school or Sunday school in the country. Accompanying each unit will be a "Speaker's Manual" with suggestions for publicity, platform manners, introduction, and all the other elements involved in good presentation of the facts about plastics.

Furthermore, the scripts are keyed to the film strips in such a way that a salesman specializing in one or two kinds of plastics may put in a plug for his own proposition without disturbing the balance of interest.

In our opinion these three new public relations tools are bound to receive hearty acclaim and wide use in the industry.

NEW CUMBERLAND "STAIR-STEP" DICING METHOD

Dices FULL RANGE of Plastic Materials!

"STAIR-STEP" DICING MACHINE

Plastic sheet material enters machine at right and is processed into cubes below.

CUTS SHEET STOCK INTO UNIFORM CUBES!

Now You Can Choose From TWO Cumberland Dicing Methods

NEW "STAIR-STEP" METHOD is the "universal" dicing method. It dices the *full range* of plastic materials having widely varying physical properties.

WELL-KNOWN "NOTCHED-KNIFE" METHOD dices vinyl materials of medium plasticizer content, vinylidene chloride, and other materials having suitable physical properties.

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Cumberland's "Stair-Step" dicing method offers you a *completely new* method of dicing. Perfect cubes are cut from sheet stock in one shearing action! All sides of cubes are cut cleanly. Cubes or rectangular pellets may be produced in various sizes (1/16" to 1/2") by simply changing knives.

WRITE FOR COMPLETE INFORMATION!

This new dicing principle makes it possible to dice the *full range* of plastic materials, including polyethylene, vinyl, acetate, and nylon. Two standard machine sizes accommodate sheets up to 7" or 14" wide. Machines to handle greater widths specially built.

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Designed Specifically for Plastics . . . . To Give You Maximum Operating Efficiency and Economy

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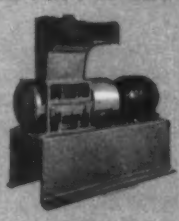
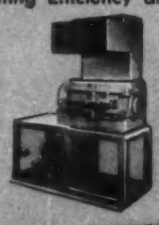


20" ALL-STEEL GRANULATOR

Rugged machine for granulating large "difficult-to-process" plastic parts. Eliminates prior band-sawing. 8" x 20" throat opening.



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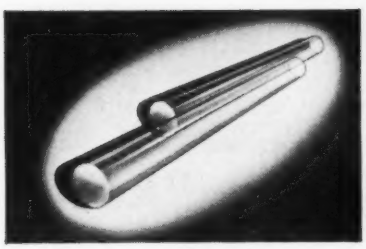
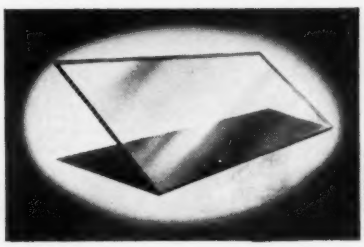
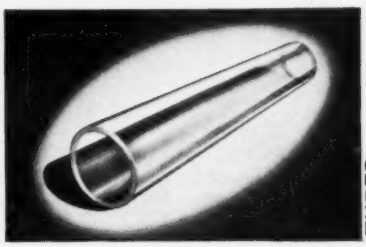

RODS


SHEETS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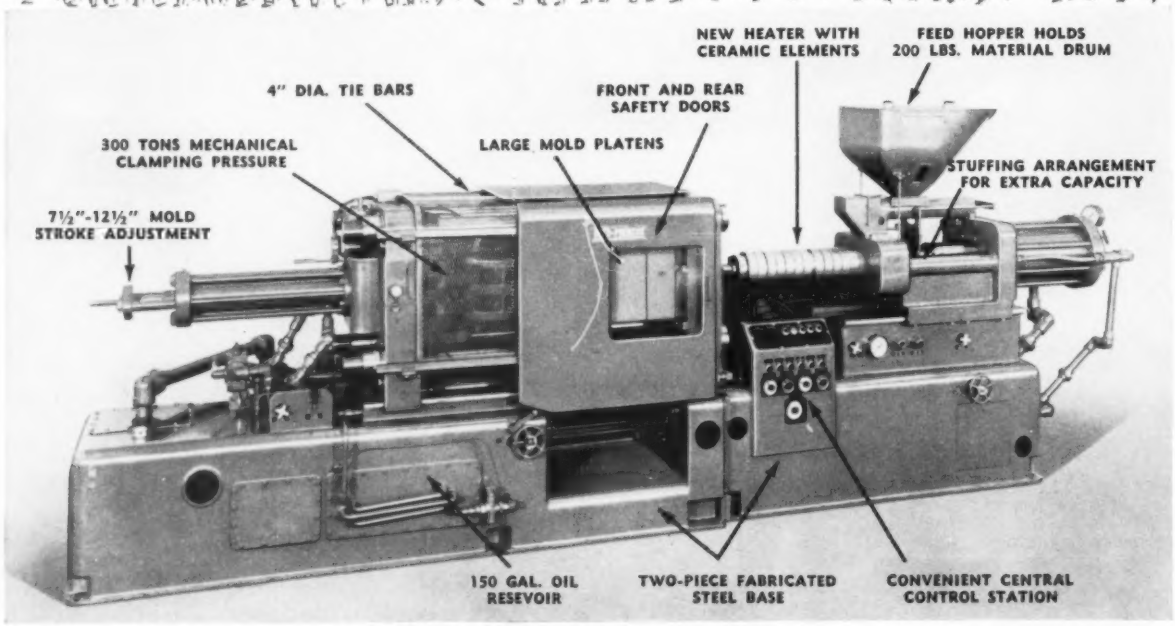
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We hope you were able to see the 300T-12/16 in operation, together with the fast-cycling Reed-Prentice 175T-4/6 oz. machine which was producing plastic parts on fully automatic cycles.

If you missed seeing these new "REEDS" at the show, you can get full details on them by contacting your nearest Reed-Prentice representative or writing to our main office for Bulletins 554-46 and 554-12.

"REEDS" available in 4, 6, 8, 12, 16, 20, 24, 32 and 48 oz. models

SPECIFICATIONS	175T-4/6	100-8	300T-12/16	400T-16/20	450T-20/24	600T-32/48
Mold clamping pressure, tons	175	275	300	400	450	600
Mold clamping stroke	5-8"	10¼"	7½-12½"	8-14"	16"	24"
Platen size (WxH)	22x24¼"	21x25"	29x32½"	38x36"	45x40"	54x45"
Mold size, max.	13½ x24¼"	21x14¼"	29x20½"	38x23½"	45x25½"	54x26½"
Diameter of tie bars	3"	3¼"	4"	4½"	5"	6"
Rated casting area sq. in.	75	125	150	175	200	300
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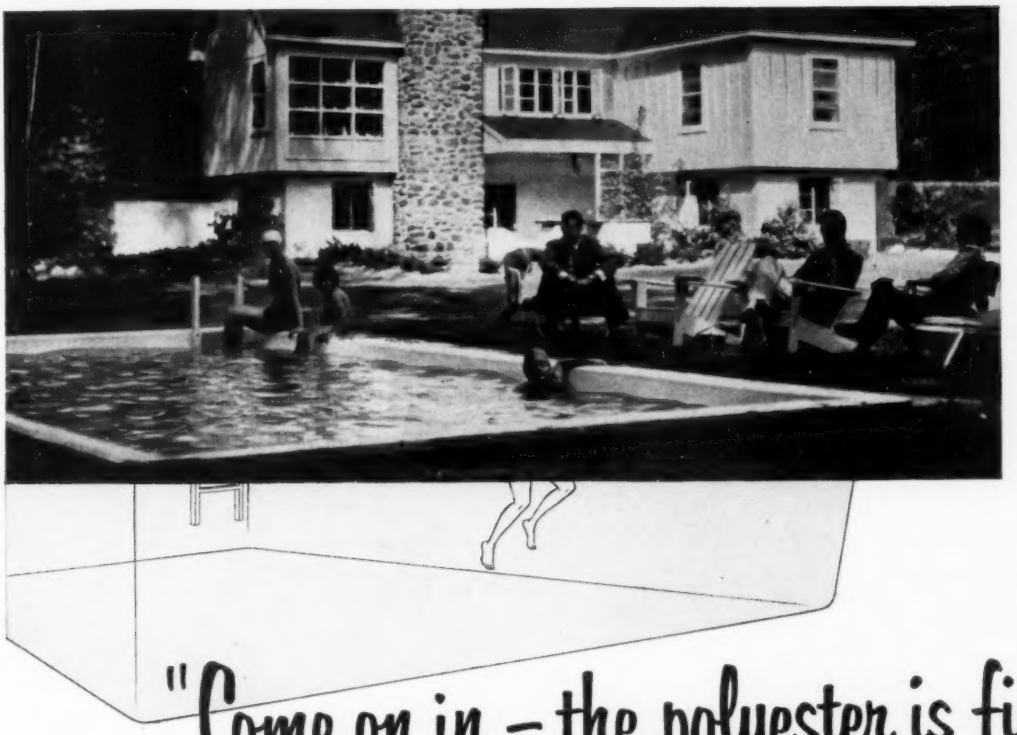

"Come on in – the polyester is fine!"

Here is a suburban swimming pool made of glass cloth impregnated with polyester resin. It could be a contemporary chair ... a corrugated translucent roof over a terrace ... a storage tank for corrosive chemicals ... a mannequin in a store window ... an automobile body or an LCVP landing craft. For all these products and hundreds more are now being made of polyester resins reinforced with such fillers as glass cloth, glass mat, fabric or paper.

Polyester resin is a liquid plastic. When combined with a suitable reinforcing material and given the desired shape it can be cured or set (at room temperature) into a hard, infusible solid with a strength-weight ratio exceeding that of steel, and with dimensional stability sufficient for precision work. In addition, this plastic sandwich is virtually corrosion-proof, and exhibits superb thermal and excellent electrical characteristics.

Celanese Corporation, Marco Products Dept., pioneered in the development of polyesters. It was this department that first developed for fabricators a simplified molding technique whereby items of large size could be molded in a single operation—on a production basis that introduces economy and efficiency to a hitherto time-consuming operation.

Already, Marco* Resins are solving design and production problems of the most radical sort. They offer far more latitude in design ... greater ease in fitting form to function ... broader accommodation of the present trend toward monolithic construction.

It will pay you to understand the myriad possibilities of these versatile materials. For detailed descriptive literature write Celanese Corporation of America, Plastics Division, Marco Products Dept. 101-G, 290 Ferry Street, Newark 5, N. J. Canadian affiliate, Canadian Chemical Company, Ltd., Montreal and Toronto.

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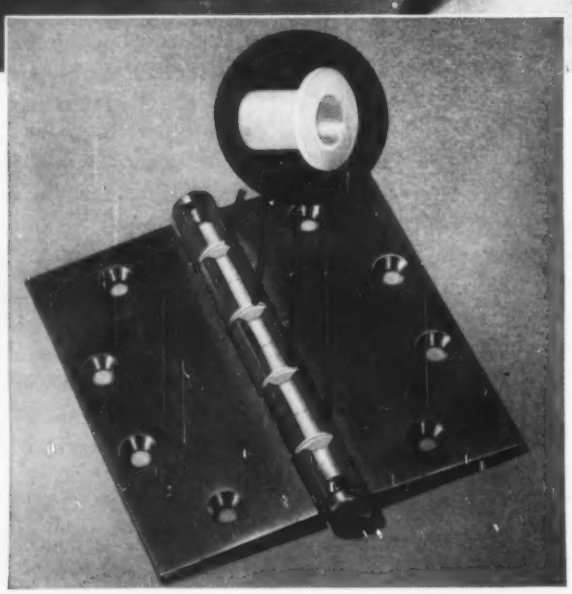
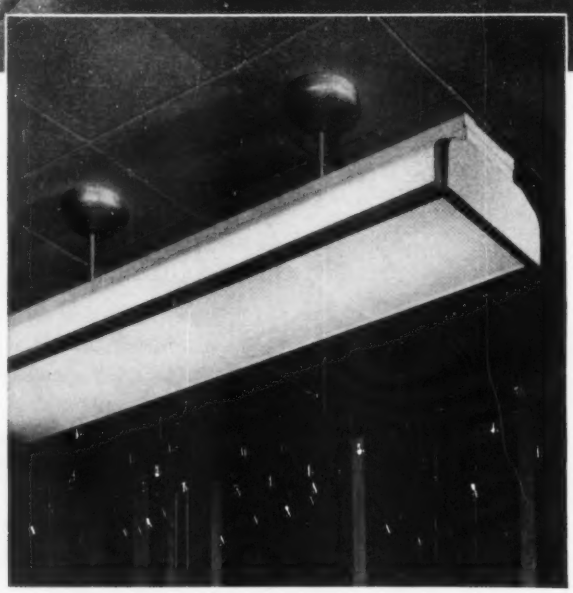
4 more examples of

*"**ALATHON**" for ice tray that stays flexible despite cold, feels warmer to the touch.*



*"**ZYTEL**" **NYLON** for hinge bearings that have great wear resistance, need no oiling.*



*"**LUCITE**" for shatter-proof lighting fixtures that diffuse light.*

advanced product engineering

Every day molders and manufacturers combine their experience to develop useful new applications for "Zytel" nylon, "Alathon," "Teflon" and "Lucite." These unique engineering materials have helped thousands of manufacturers lower production and maintenance costs. At the same time, end users have a better product. For example:

"ALATHON"* polyethylene resin makes possible an ice tray that stays flexible, and is warmer to the touch than conventional material used for ice trays . . . more pleasant to handle. "Alathon" contains no plasticizer —it won't affect the taste of the ice and is odorless and non-toxic. "Alathon" has a very low rate of water-vapor transmission and won't corrode from moisture or many chemicals. And it can be mass-produced easily by economical injection molding. These ice trays are made by the Gits Molding Corp., Chicago, Ill.

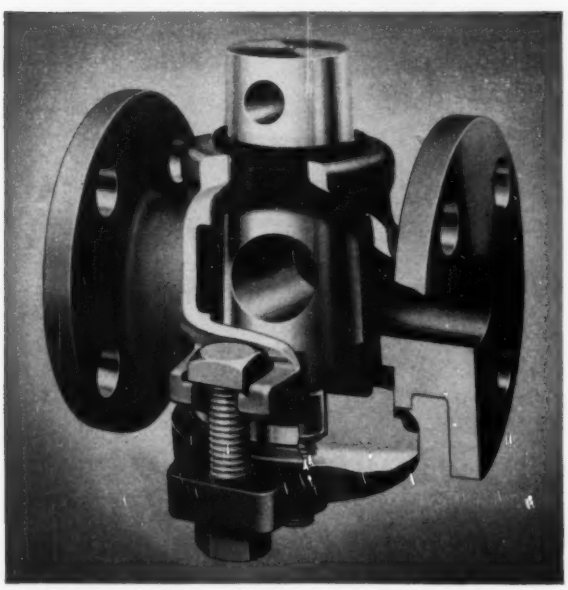
"ZYTEL"† nylon resin makes an exceptionally wear-resistant bearing for heavy-duty door hinges. On a department-store front entrance, hinges with bearings of "Zytel" have already lasted three times as long as the hinges previously used. With these bearings, hinges don't have to be oiled—yet they don't bind or squeak in operation. They're strong and resilient . . . corrosion-resistant. These hinges are manufactured by the H. S. Getty Co., Inc., Philadelphia, Pennsylvania.

"LUCITE"* acrylic resin is a sparkling-clear, shatter-proof material that's ideal for lighting fixtures. "Lucite" does not craze on exposure to weathering. It has excellent light-diffusing properties—reduces glare and insures an even distribution of light. "Lucite" is easy to clean, light in weight.

"TEFLON"* tetrafluoroethylene resin is inert to all chemicals normally encountered in industry. It reduces replacement and maintenance costs by outlasting other materials by a wide margin. Valve components of "Teflon" operate over a wide range of temperatures, feature extremely low coefficient of friction, have good impact strength and zero water absorption.

Investigate the properties of this Du Pont family of engineering materials. The applications described on these pages are typical of the product improvements possible when design and service requirements are evaluated in terms of these unique materials. For further information on the properties and uses of these materials, use the coupon or write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 307, Du Pont Building, Wilmington 98, Delaware.

*REGISTERED TRADE-MARK OF E. I. DU PONT DE NEMOURS & CO. (INC.)
†"ZYTEL" IS THE NEW TRADE-MARK FOR DU PONT NYLON RESIN



"TEFLON" for non-adhesive valve components with a low coefficient of friction.

DU PONT
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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 307, Du Pont Building, Wilmington 98, Del.

Please send me more information on the Du Pont engineering materials checked. "Zytel" nylon resin ☐; "Alathon" polyethylene resin ☐; "Teflon" tetrafluoroethylene resin ☐; "Lucite" acrylic resin ☐. I am interested in evaluating these materials for_____

Name_____ Position_____

Firm Name_____

Street Address_____

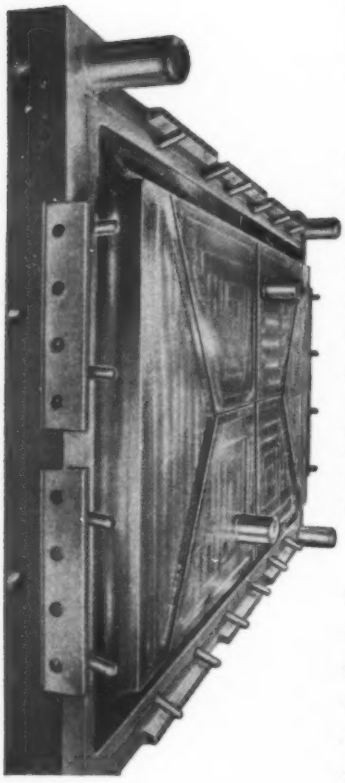
City_____ State_____

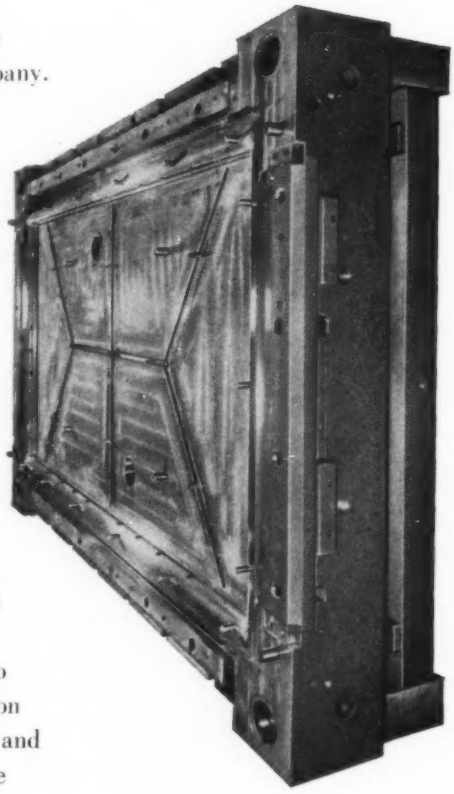
Type of Business_____

here's why

CRUCIBLE MOLD STEEL ***was chosen for largest injection mold...***

Crucible CSM 2 mold steel was the choice for this injection mold — the largest yet produced. From it, the Cambridge-Panelyte Molded Plastics Company, a subsidiary of St. Regis Paper Company, turns out trim frames for Carrier home freezers. The mold itself was made by Eagle Tool and Machine Company.





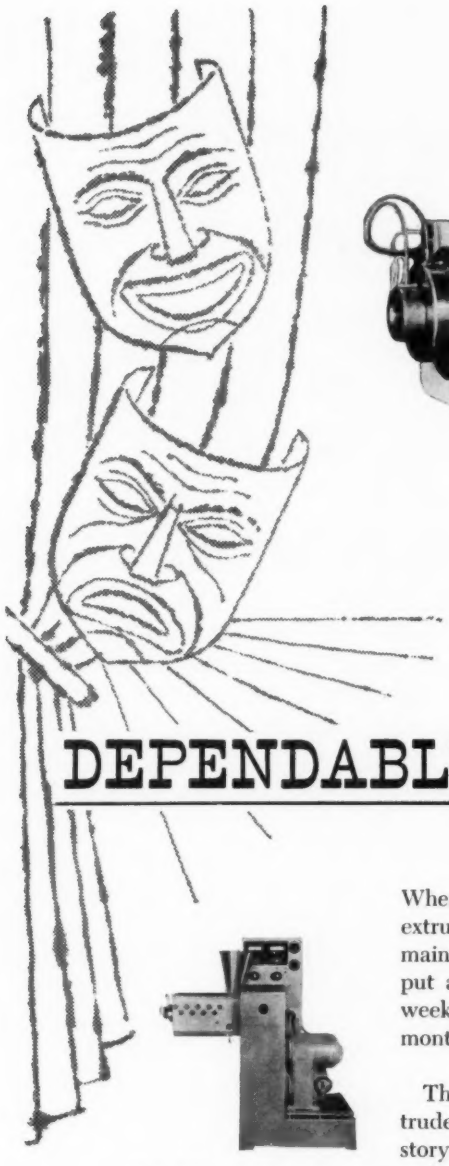
There are good reasons why leading manufacturers specify Crucible. First of all, Crucible mold steels are actually tool steels, made by the electric-furnace process to tool steel standards . . . in the country's leading tool steel mill. It's this painstaking care that pays off in uniform, high-quality steels.

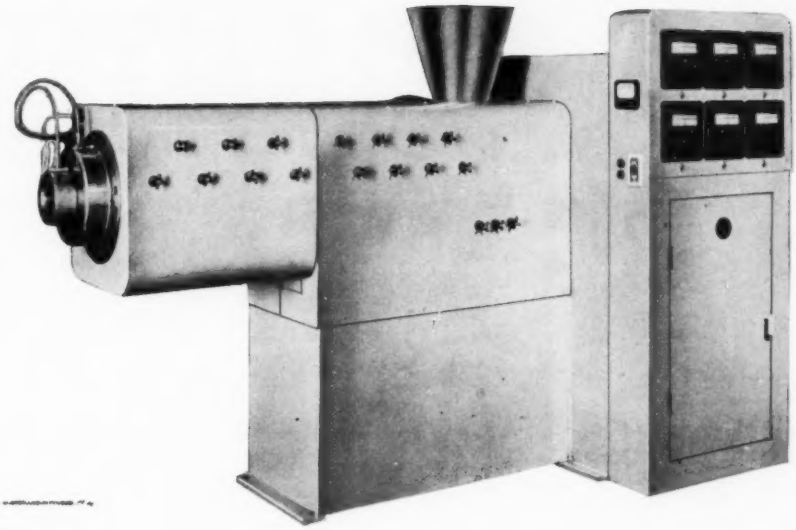
It will pay you to specify Crucible mold steel for your next job. Crucible engineers are available to work right with you on the selection or fabrication of mold steels . . . and when you choose the correct grade you can get it *fast* from your local Crucible warehouse.

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking **MOLD STEELS**

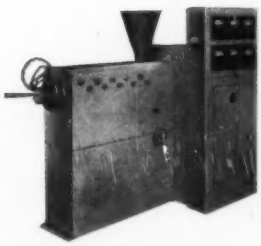
CRUCIBLE STEEL COMPANY OF AMERICA • TOOL STEEL SALES • SYRACUSE, N. Y.





DEPENDABLE PERFORMERS...ALL!

Materials extruded include nylon, Kel-F, polystyrene, acetate, methacrylate, polyethylene, polyvinyl chloride and Formvar.



MPM extruders, in all sizes, are in daily use in more than eighteen countries, outside of the United States.

When the "show must go on" MPM extruders can be depended upon to maintain close tolerances, high output and uninterrupted production, week after week, month after month, year after year.

The experience of countless extruders all over the world tells the story: MPM extruders are known to have the built-in endurance that insures production that is both continuous and profitable.

MPM extruders, in all sizes, have screws, strainers, cylinders, die heads, hoppers, and other vital parts which are made of corrosion resistant materials through and through.

And MPM extruders won't be outdated by the introduction of new plastic materials. Some models have as many as fifteen cooling zones . . . all have internally heated or cooled screws. Proof of their versatility can be found in the fact that nearly all material manufacturers use MPM's for laboratory development work.

Indications are that the demand for extruded products will grow for many years to come. Owners of MPM extruders and auxiliary equipment will be in the best position to meet this demand. Ask today for full data about an MPM extruder that will be your most dependable performer.

modern plastic machinery corp. mpm

West Coast Representative
4113 West Jefferson St.
Los Angeles 16, Calif.

15 Union St., Lodi, N. J., U. S. A.
Cable Address: MODPLASEX

A PARTICLE OF DIFFERENCE

is the big difference in dry blending PLIOVIC

DRY blending is becoming more and more popular among all processors of vinyl resins. Faster production, lower costs, less expensive equipment, a shorter heat history and higher product quality are the reasons. But to achieve such results, a special type of resin is required.

Goodyear vinyl processing engineers have determined that primarily a good dry blending resin must be capable of absorbing plasticizer at a rapid yet uniform rate. It must give a dry or sandy, free-flowing mix that does not pack or bridge. Such a resin must also be easily processed on any type of forming equipment. And it must do so with no sacrifice in physical properties.

To meet these requirements for a good dry blending resin, Goodyear vinyl resin specialists worked out monomer types and ratios, molecular weights, and methods of polymerization. But the most important findings were the particle size, type and distribution that spelled the difference in producing a good dry blending resin.

By using the most modern techniques available, vinyl resin particles were produced in the desired size, shape and structure. The size range was confined within very narrow limits. And the results were outstanding PLIOVIC DB (dry blending) resins for extruding, calendering and molding.

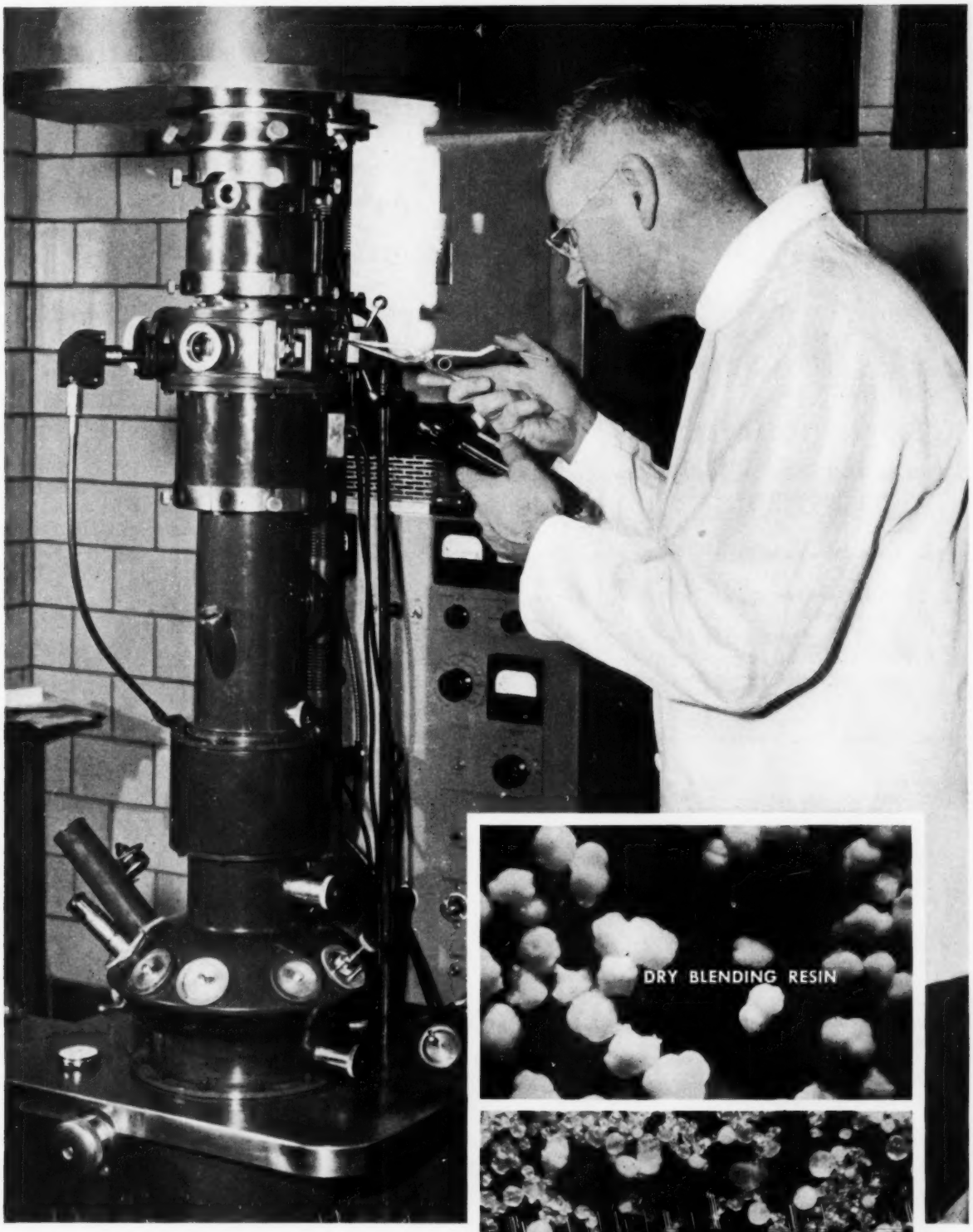
And the work continues. While the PLIOVIC dry blending resins are the finest to reach the market to date, even greater PLIOVIC resins are in the offing. For samples and technical assistance, write to:

Goodyear, Chemical Division, Akron 16, Ohio.

CHEMICAL GOODYEAR DIVISION

Chemigum, Pliobond, Pliolite, Plio-Tuf, Pliovic—T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

Use-Proved Products — CHEMIGUM • PLIOBOND • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS — The Finest Chemicals for Industry



THE DIFFERENCE IN PARTICLES that gives you better dry blending PLIOVIC resins is obtained with the help of this electron microscope which magnifies from 5 to 50,000 times. In these photomicrographs, note the uniformity in size, shape and structure of the particles of the dry blending resin as compared to those of the conventional resin.

B & J PLASTIC GRANULATORS

FOR BESIDE-THE-PRESS & ACCUMULATED SCRAP GRINDING

MORE THAN 5,000 BUILT AND SOLD

COMPARE THESE ADVANTAGES

- ☐ **LOWEST COST** — on a per pound production basis, the lowest cost grinder on the market!
- ☐ **NO FLY BACK** — no leakage!
- ☐ **THUMBSCREW REMOVAL OF HOPPER** — done in seconds without tools!
- ☐ **FASTEST CLEANING** — entire cutting chamber fully machined — corners and crevices eliminated!
- ☐ **HOT & COLD SPRUES** handled simultaneously!
- ☐ **SPECIAL HOPPERS** available to handle any length sprue or reject!
- ☐ **GRINDERS SUPPLIED WITH REMOVABLE BIN** for granules or chute for direct discharge into drum!
- ☐ **DOUBLE SHEAR KNIFE ACTION** readily cuts soft or hard plastics!
- ☐ **CAST IRON, STEEL or STAINLESS STEEL** construction available!
- ☐ **ALL MOVING PARTS ENCLOSED or guarded!**
- ☐ **MACHINES ALSO AVAILABLE WITH CASTERS** for portability!

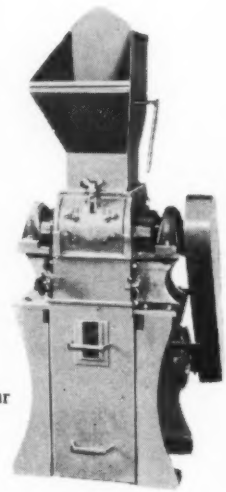
3 CONVENIENT PAYMENT PLANS

- Regular 30-day terms
- Deferred Payments
- Lease-Purchase Arrangements

B & J Grinders incorporate every up-to-the-minute engineering advance, backed by over 50 years of experience. No other grinding machine manufacturer can make this statement.

TESTING LABORATORY HELPS YOU CHOOSE THE RIGHT GRINDER

For assistance in choosing the right machine for your requirements, send samples of your material for grinding in our testing laboratory.



LABORATORY 251
capacity up to 150 lbs. per hour

15 models to meet the grinding requirements of the smallest or largest injection or extrusion plant. *Write for brochure today.*

MAKE YOUR OWN FREE 10-DAY TRIAL TEST
Write for full details

BALL & JEWELL, INC.

22 FRANKLIN STREET **EVergreen 9-6580** **BROOKLYN 22, NEW YORK**

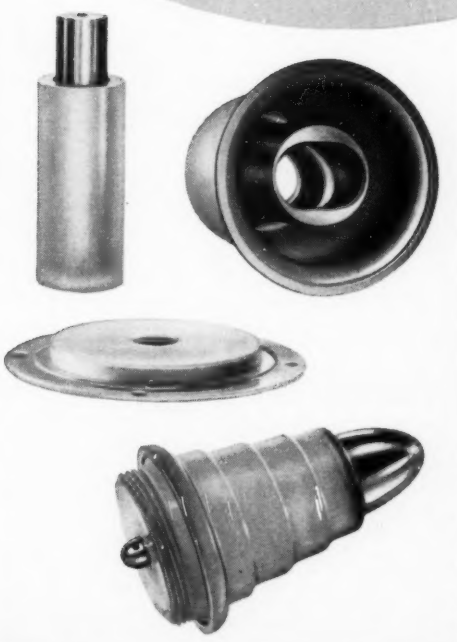
B & J HOPPER HEATER-DRYERS • PNEUMATIC MATERIAL DISCHARGE SYSTEMS
EASTERN REPRESENTATIVES—LEWIS INJECTION MOLDING MACHINES

RESISTS almost EVERYTHING

KEL-F* properties

- Chemically Inert to All Acids, All Alkalis, Solvents
- Excellent Compressive Strength . . . 32,000 to 80,000 psi.
- High Dielectric Properties
- Zero Water Absorption
- Wide Temperature Utility—from −320° F. to +390° F.
- Dimensionally Stable—unaffected by temperature, moisture, age
- High Impact Strength. Low Cold Flow
- Non-wetting

*Trade Name of M. W. Kellogg Co.



KEL-F* Parts Compression-Transfer-Moulded by K-K Of Special Interest to the Chemical, Electrical and Food Processing Industries

Check the partial list of KEL-F properties. Determine for yourself where and how these characteristics can improve your product or procedures. If the application is highly specialized, then the Kurz-Kasch method of compression-transfer moulding *might* be your logical answer.

As examples of the benefits you can expect, the chemical pump parts and integrally-moulded valve liners pictured above will, through their chemical inertness alone, give infinitely more satisfactory service and freedom from expensive maintenance and replacement. Also, note a large electrical insulator moulded around a complex insert.

These are the kinds of fluorocarbon applications we specialize in—those parts that can best be compression-transfer moulded. Send us your inquiries on KEL-F—on Teflon—on moulded glass-filled polyesters—or any thermo-setting materials. We're equipped and ready for compression, transfer and plunger moulding exclusively—and anxious to work into your plans for the earliest feasible moment. Just write or call.

KURZ-KASCH

Specialists in Thermo-Setting Plastics for 37 years

Kurz-Kasch, Inc. • 1415 S. Broadway • Dayton 1, Ohio

BRANCH SALES OFFICES: **New York,** *Mt. Vernon MO 4-4866* • **Rochester,** *Hillside 4352* • **Chicago,** *Merrimac 7-1830* • **Detroit,** *Trinity 3-8200* • **Philadelphia,** *Hilltop 6-6472* • **Dallas, Logan** *5234* • **Los Angeles,** *Richmond 7-5384* • **St. Louis,** *Parkview 5-9577* • **Atlanta,** *Elgin 0870* • **Toronto,** *Riverdale 3511.*

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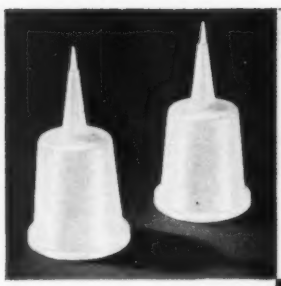
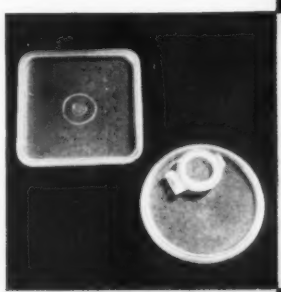


NOBODY HAS AS MUCH EXPERIENCE AT MOLDING POLYETHYLENE AS TUPPER!



Tupper Seals are air and liquid-tight flexible covers. The famous Pour All and Por Top covers are designed for easy dispensing. They are made in sizes to fit all Tupperware containers.

The logical molder for you to consult regarding that product or package of yours which is to be made of polyethylene is Tupper. Tupper has done more than any other molder to make molded polyethylene a practical reality.

Aside from having designed, patented, and promoted successful seals, closures, and dispensers for polyethylene containers, the Tupper Corporation has vast experience in *every phase* of polyethylene packaging and polyethylene injection molding. This experience will be of major importance in improving your product, in reducing your costs, when Tupper goes to work for you.

Tupper's combination of experience, technical ingenuity, and the most modern equipment is at your service for the custom molding of your product in polyethylene. You can do no better than the best ... and the best at molding polyethylene is Tupper!

When equipped with Tupper Seals, Tupper Canisters, Sauce Dishes, Wonder Bowls, Cereal Bowls and Funnels in various sizes are the most versatile reusable containers you have ever seen.

TUPPER!
TRADE MARK

TUPPER PRODUCTS ARE FULLY PROTECTED

About 150 United States and foreign patents and patents applied for, plus numerous trademarks and copyrights, cover the design and manufacture of the various types of Tupper Seals and other Tupper Products. Unauthorized manufacture of items covered by Tupper patents will subject infringers to prosecution.

TUPPER CORPORATION

Manufacturers of — CONSUMER, INDUSTRIAL, PACKAGING AND SCIENTIFIC PRODUCTS

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Farnumsville, Mass., Blackstone, Mass.
Orlando, Fla., Montreal, P. Q.
Showrooms: 225 Fifth Ave., N. Y. C.

Address All Communications To: Dept. M-4

Selected by the Newark Die Company for this large plastic mold...

Photograph—courtesy of Newark Die Company

Cascade

precipitation-hardened die steel

Because of its unique properties, Latrobe's CASCADE precipitation-hardened die steel was selected by Newark Die Co. as the best possible steel for this large mold used to form the handsome grills for Philco Air Conditioning units.

Cascade's outstanding machining and finishing properties together with its high strength and uniform hardness throughout large blocks make it the best choice for prehardened plastic molds.

Call your Latrobe representative or write for complete data today!

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LATROBE
STEEL COMPANY
LATROBE, PA.

Investigate All The Advantages of Plastoleins®

DOZ DIOZ

The Most Versatile LOW-TEMPERATURE *Plasticizers Available*

- ***Unmatched Low-Temperature Flexibility***
- ***Unusually Low Volatility***
- ***Low Water Extraction***
- ***Excellent Heat & Light Stability***
- ***High Plasticizing Efficiency***
- ***Extremely Low Soapy-Water Extraction***

Plastoleins 9058 DOZ (di-2-ethylhexyl azelate) and 9057 DIOZ (di-iso-octyl azelate) possess all the properties of a basic plasticizer and...in addition, offer all the advantages of low-temperature flexibility.

This balanced combination of important properties has led to its extensive use in all types of vinyl compounds including calendered and cast films, calendered sheeting, calendered and dispersion coated fabrics, and all types of extruded products.

Why not give your product better performance and extra sales-appeal by using DOZ or DIOZ. Write to Dept. F7 today for descriptive literature and samples of Plastolein 9058 DOZ (di-2-ethylhexyl azelate) or Plastolein 9057 DIOZ (di-iso-octyl azelate).

DOZ DOZ DIOZ DOZ DIOZ DOZ DIOZ DOZ DIOZ DOZ DIOZ DOZ DIOZ DOZ DIOZ

Emery

Fatty Acids & Derivatives
Plastolein Plasticizers
Twitchell Oils, Emulsifiers

Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio

New York • Philadelphia • Lowell, Mass. • Chicago
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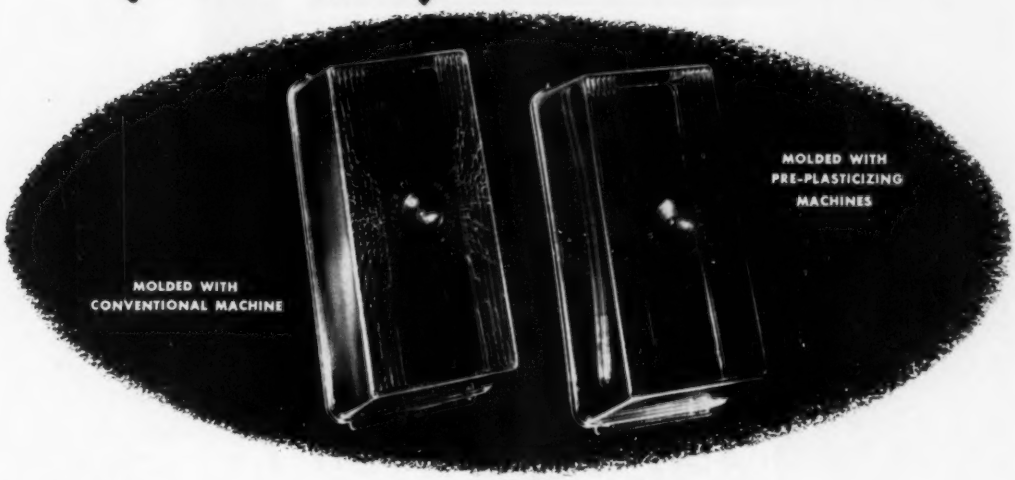
Warehouse stocks also in St. Louis, Buffalo, Baltimore and Los Angeles

EXPORT: 5035 RCA Bldg., New York 20, New York

WILL YOUR PARTS PASS *The Heptane Test?*



H-P-M Pre-Plasticizer *Guarantees* High-Strength, Strain-Free Parts!

Dipping molded parts in Heptane solution gives you visible evidence of any strains that may be present in the molded piece. Buckeye Molding Company, famous as producers of Flexeel containers, proved that their H-P-M 48 oz. pre-plasticizers give them strain-free parts on this job.

On this refrigerator dish, injected in a 4-cavity mold, Buckeye increased production 67% . . . achieved 25% better quality . . . and scrapped only 18 parts in a 24 hour period.

Now equipped with a positive shot measuring device, H-P-M's model 400-P-48 provides zero injection pressure after the mold cavities are filled. There is no chance of "packing". Mold release compounds are no longer required! No other machine offers you this feature!

Yes, H-P-M pre-plasticizers will give you deeper draws . . . faster cycles . . . better dry-coloring . . . lighter weight parts . . . less part distortion . . . a greatly improved product . . . plus proven savings in production costs. Write for full details today!

for **TOUGH** molding jobs...

Photo courtesy Plastiline, Inc.

METASAP STEARATES

deliver easier mold release

For molding those intricate shapes, for deep drawing, or for larger-than-average pieces, the tested way to easy ejection is to use the right Metasap Stearate in your molding compound.

There are two ways to use these Stearates. You can incorporate Metasap Zinc or Calcium Stearates into the molding compound itself, or simply dust them on the molding surface. Either way, you get improved lubrication at lower ejection pressures. You step up your output, get fewer rejects and better finished products. Your molds last longer too.

Metasap Technical Service is prepared to help you find the materials and mixing procedures best fitted to your production methods.

And to produce economical plastigels . . . Metasap offers a complete line of quality stearates, effective as thickening agents. Free testing samples of Magnesium, Barium, Calcium, or Aluminum Stearates are yours on request.

METASAP CHEMICAL COMPANY
Harrison, N. J.

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METASAP CHEMICAL COMPANY

Chicago, Ill. • Boston, Mass.
Cedartown, Ga. • Richmond, Calif.

METASAP STEARATES

the cleanest stearates made

The Ass, the Cock, and the Lion

An Ass and a Cock lived in a farmyard together. One day a hungry Lion passed by and seeing the Ass, resolved to make a meal of him. Now they say there is nothing a Lion hates so much as the crowing of a Cock, and at that moment the Cock happened to crow. The Lion made off with all possible haste. The Ass, amused to think that a Lion should be frightened of a bird, plucked up courage and galloped after him, delighted with the notion of driving the king of beasts before him. However, he had gone no great distance when the Lion turned sharply around upon him, and made an end of him in a minute.

False confidence often leads to disaster. —*Aesop*

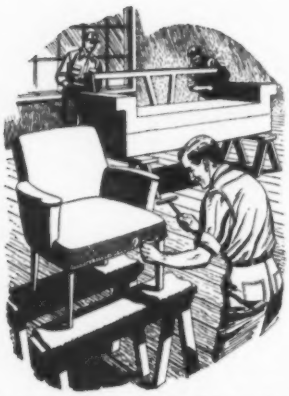
You can place your confidence in Plenco with the assurance of our ability to completely understand and help solve your production problems.

PLEN[illegible]ENOLICS

FOR BETTER PLASTIC PRODUCTS

PLASTICS ENGINEERING COMPANY

Sheboygan, Wisconsin



New Wellington Sears spun rayon fabrics give a smooth, good-looking finished surface and improved tear strength to upholstery and other coated products.

"Columbus" cotton sheeting is widely used for coatings demanding high quality, flexibility, easy handling, and an absolute minimum of production rejects.

YOU GET STYLING PLUS DURABILITY WITH WELLINGTON SEARS "LANTUCK"

A "natural" for deeply embossed patterns, Lantuck non-woven fabric has been specially developed by Wellington Sears for vinyl coating. Its random fibers are bonded with a specifically selected heat-sensitive resin which affords complete fusion with vinyl for easy molding and shape retention.

In addition to embossability, Lantuck features true multi-directional strength because of its completely random distribution of fibers.

Lantuck may be calender coated, laminated or electronically sealed to vinyl film. Highly flexible, it provides smooth surface and high gauge-weight ratio at reasonable cost. Stitch and tear strength is improved without interfering with the vinyl film's soft, pliable hand, so important in upholstery, auto seat covers and the like.

Lantuck for coating is available in 54 to 56 inch width in weights of about 3 to 4 ounces per square yard. For further facts—including development work now in process—contact our nearest sales office.

Write for a free copy of "Modern Textiles for Industry" which includes pertinent information on fabric-and-plastic applications. Address: Wellington Sears, Dept. 1041, 65 Worth Street, New York 13, N. Y.

Superior Fabrics for Coating and Laminating

Single filling ducks	Broken twills
Army ducks	Drills
Single and plied-yarn chafers	Sheetings
Special ducks	Nylon, rayon, Orlon* and other synthetics
Sateens	Lantuck non-woven fabrics
Twills	

*DuPont's trademark for its acrylic fiber

Wellington Sears

A SUBSIDIARY OF WEST POINT MANUFACTURING COMPANY

FIRST In Fabrics For Industry

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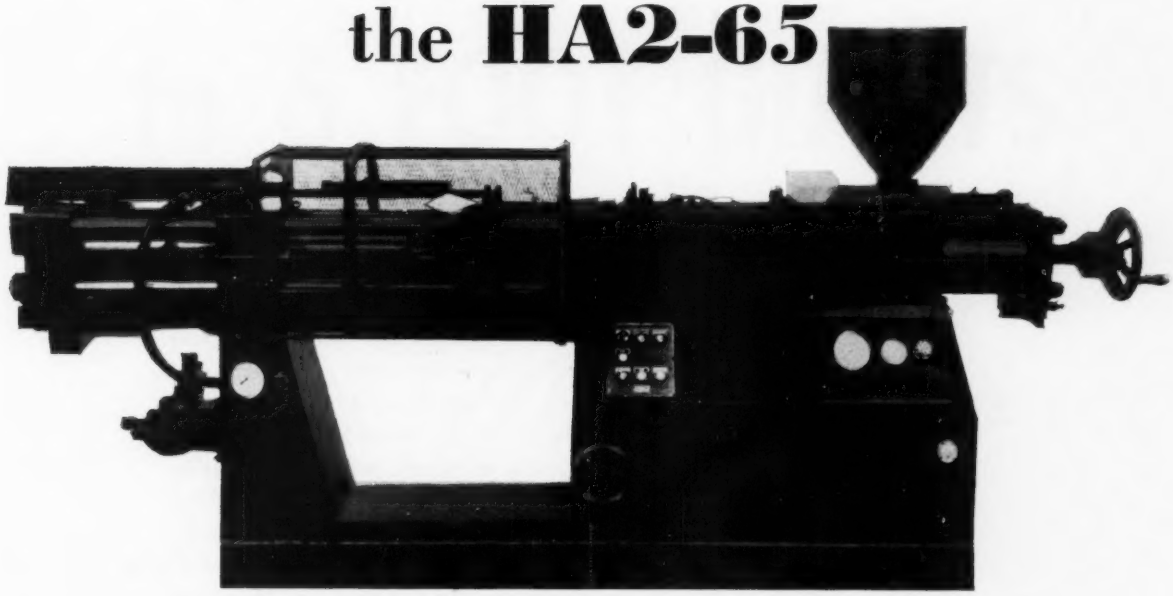
Offices In: Atlanta • Boston • Chicago • Detroit • Los Angeles • New Orleans • Philadelphia • San Francisco • St. Louis

A NEW AUTOMATIC

By *Impco*

the HA2-65



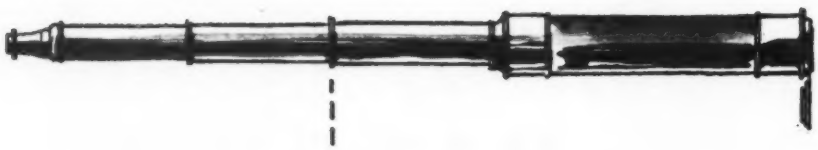
AUTOMATIC INJECTION MOLDING MACHINE-
ALSO OUTSTANDING AS A SEMI-AUTOMATIC MACHINE

Injection Capacity—2-3 ounces
Plasticizing Capacity—60 pounds per hour
Clamping Pressure—65 tons
Clamp Die Stroke—adjustable up to 15 inches
Maximum Die Thickness for 15" stroke—15 inches
Dry Run—13 cycles per minute at 15" clamp stroke
14 cycles per minute at 5" clamp stroke
Automatic, Semi-automatic and Manual Operation
High Speed, Low Pressure Closing

Designed to combine HIGH SPEED with HIGH PLASTICIZING CAPACITY!

IMPCO

IMPROVED
MACHINERY INC.
NASHUA, NEW HAMPSHIRE



What do you look for in a moulding material?

Maybe your main need is cheapness, maybe lightness or freedom from design limitations. If you want all three, then polystyrene is the answer. And where polystyrene is the need, Kleestron Colorant Blend 604 is the choice. This brand, produced under ideal conditions at Welwyn Garden City, England, combines the usual virtues of polystyrene with an unsurpassed degree of *versatility*. If that is what you're looking for you need look no further.

the Versatile plastic

Supplied as fines, granules or a mixture of both

KLEESTRON COLORANT
BLEND 604

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from one-inch "Midgets"

to 6 FOOT GIANTS

...**"commonwealth** *Plastics*

proves

It Can be Done"

From
COMMONWEALTH
for YOU:

Design
Engineering
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Extrusion
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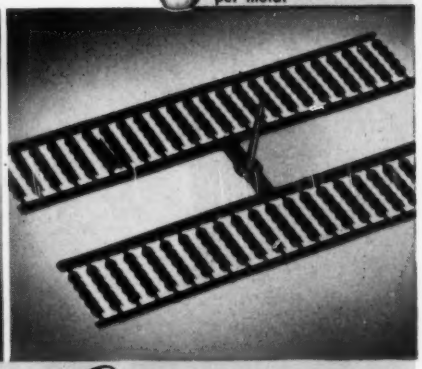
Spray Painting
Wire Coating
Assembly
Finishing

FIRST to manufacture 3-D Plastic glasses, Commonwealth began at the design stage... pushed production to a million per day within 90 days!

Multi-cavity bead die, typical of over 10,000 stocked by Commonwealth ... from 1 to 225 cavities per mold.



Facilities at:

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Internal wiring for extruder and control panel complete to coded terminals for quick installation at any location.

FOUR SEPARATE MAIN COMPONENTS

● "Tailored" Screw ● Independent Thrust Bearing Housing

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ALL WITH IMPROVED FEATURES

for increased production, reduced maintenance and complete flexibilty. Designed to meet *ANY* requirements. Can be supplied complete with dies and take-off equipment.

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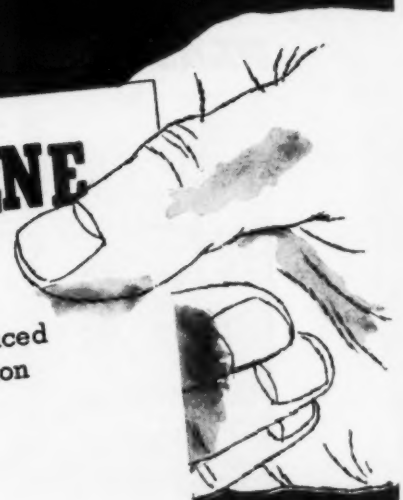
As exclusive distributors for Fostarene—Muehlstein offers you a dependable source for quality Virgin Polystyrene. Our experienced technicians and nation-wide sales organization stand ready to serve you.



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If you sell plastic scrap . . . use reprocessed plastics or have your scrap reprocessed—look to Muehlstein for reliable service. Our complete laboratory facilities and technical staff assure satisfaction, especially with color problems.

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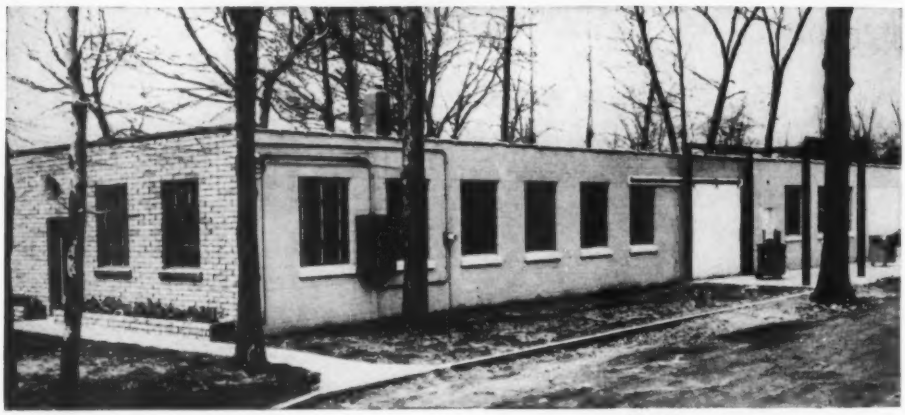
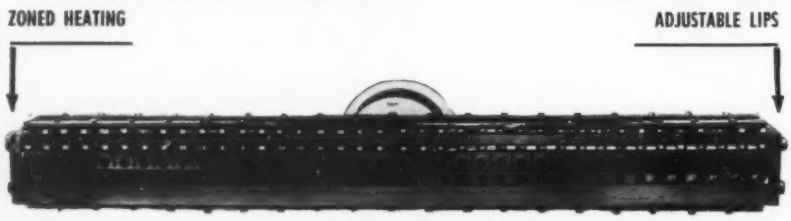
Robbins

PLASTICS EXTRUSION ACCESSORIES



Never say die . . . say Robbins die



Readily Adapted To Your Extruder

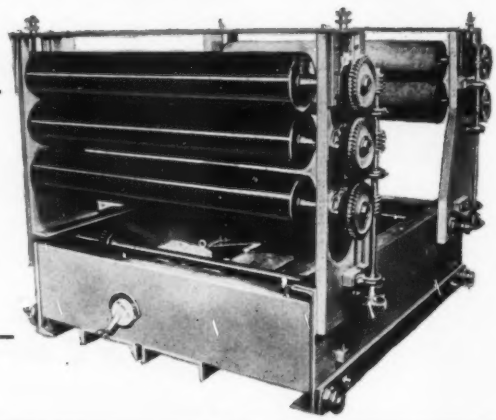
Available in Widths Up to 60"

SHEETING DIES

for High Impact Styrene • Cellulose Acetate • Butyrate

SHEETING HAUL-OFF UNITS

Complete with Superfinished rolls and incorporating a variable speed transmission driving through a heavy-duty worm gear arrangement (shown with guards removed) to provide smooth tension on the extruded sheet.



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Elkhart, Indiana

Plastics Extrusion Dies a Specialty

supported or
unsupported

Outerwear of Vinyl

Looks better
Costs less to produce
when you weld with

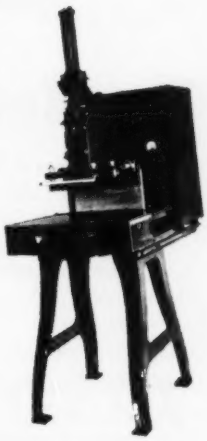
Thermatron

HIGH FREQUENCY SEALING AND HEATING EQUIPMENT

The latest look in fashion is plastic . . . jaunty simulated leather jackets, sparkling vinyl raincoats, belts, collars and accessories of every sort. And the most practical way is to weld with Thermatron. Then you avoid trouble-some perforations that lead to rips and tears.

Thermatron produces a permanent waterproof bond stronger than the material itself . . . Does it cheaper and better than any other method. Outer-wear is welded in seconds, cutting production costs drastically. Seams are smooth and even — producing a better looking garment too!

Outerwear is just one segment of plastic fabri-cation where Thermatron can help you. What do you manufacture? We'll run tests on your own material and offer sound recommendations . . . all without obligation, of course. Write today for comprehensive bulletin No. 85



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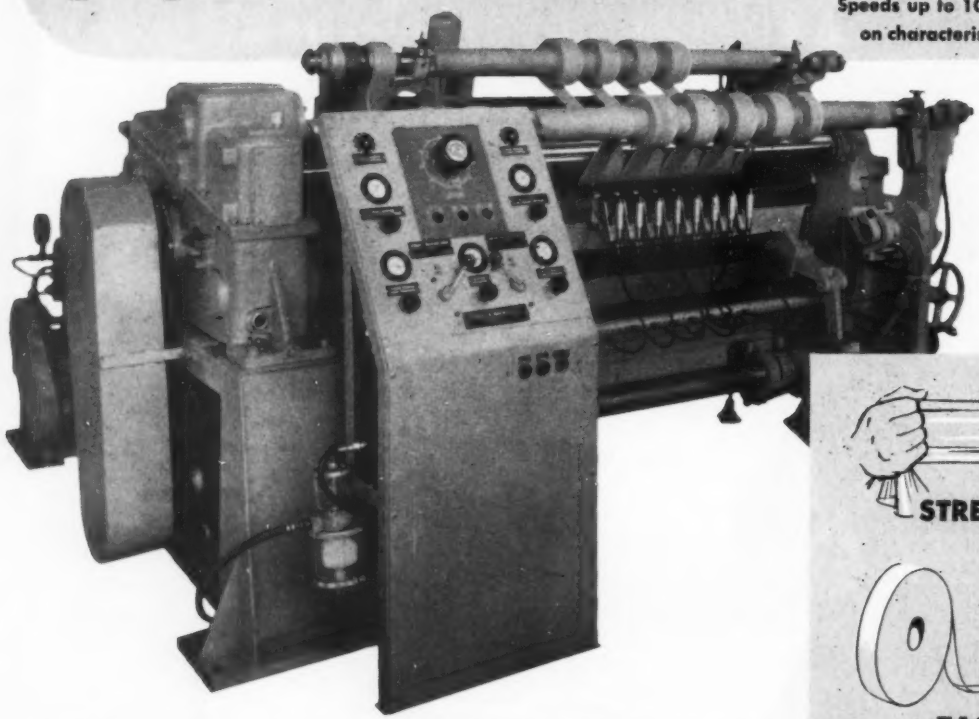
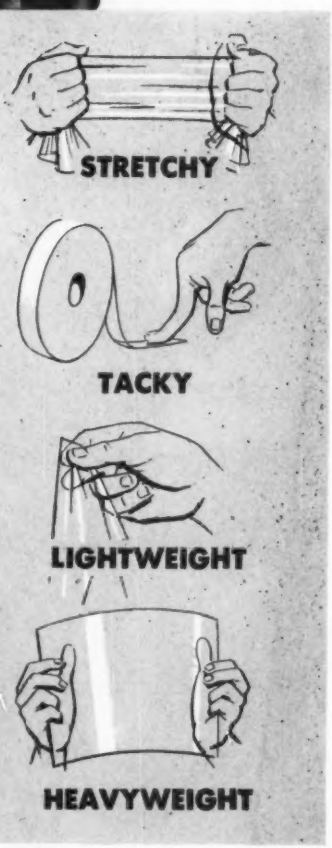
WAtkins 4-3633 • Chicago: 2753 W. North Avenue
Los Angeles: Electroseal Plastics Co., 130 No. Juanita Ave.

NOW...A SLITTER-REWINDER THAT CONVERTS INSTANTLY TO HANDLE any type of film, foil, paper or fabric...

Trim widths 42" to 62"
Finished rolls up to 20" dia.
Speeds up to 1000 fpm. depending on characteristics of the material.





The New CAMACHINE 500

Here's big news! The great new Camachine 500 . . . a versatile new slitter-rewinder that handles all types of plastic film, off-caliper papers, laminated paper, foils and other sensitive materials.

For the first time in one machine the Camachine 500 combines shear-cut, pneumatic score-cut and razor-type slitting. Camachine Sealcut* slitting units may also be used for heat-sealing the strip edges of fusible synthetic fabrics. You can make rapid on-the-spot changeovers to the slitting methods best suited to various materials.

A new high in efficiency! The central operating panel provides finger-tip control of starting, stopping, jogging, slitter pressure, mill roll tension, rewind shaft speed controls, rewind core friction, automatic rewind roll counterbalancing, and mill roll side shift. Built-in photo-electric side-register control provides constant automatic correction of side-wise movement of the web, reduces waste, assures clean, straight-sided finished rolls of uniform hardness.

*Registered Trade Mark

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Let us make a test run on your material producing rolls to your specifications. See your Cameron representative, or write today.

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AA-291

Boil proof — low breakage rate
Domestic Mouldings

Colourless, wash fast
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Surface Coatings

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Decorative Laminates

Maximum wet strength
Paper

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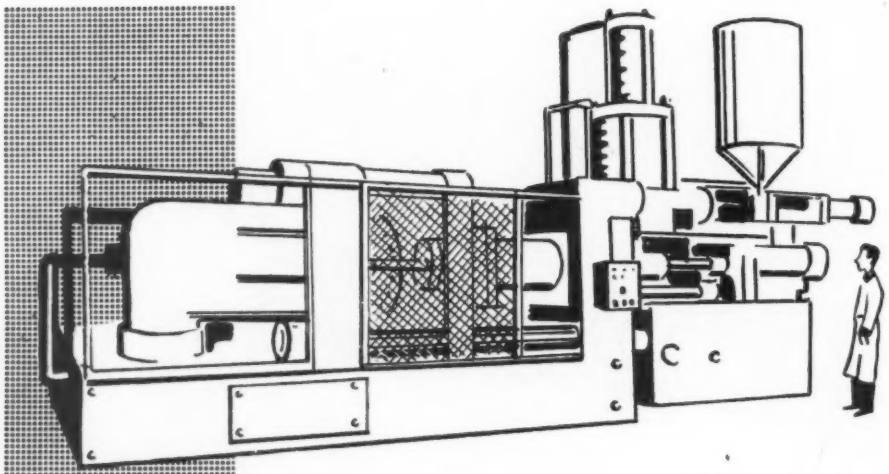
CAPACITY



. . . for the ultimate in PLASTIC MOLDING

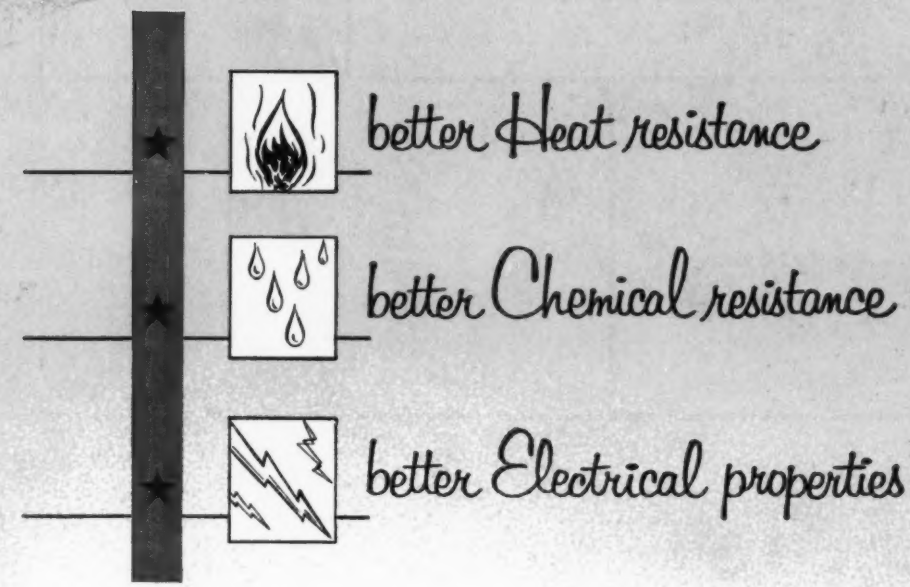
We have added a new giant injection molding machine to our already complete facilities in order to offer our customers *everything* necessary for finest plastic molding. The new machine has a capacity of 200 ounces and can handle large area moldings with amazing new speed.

If your molding program includes heavy sections with large projected areas, why not check with us. We have the answer to *all* your molding needs.

BPM Bridgeport Moulded Products, Inc.
Bridgeport 5, Connecticut

Important news!

EPON® resin 828 with new Curing Agent CL gives



If you are among the many users of Epon resin 828 for casting, laminating or other structural applications—you will welcome this new development of Shell Chemical's continuing research program.

Curing Agent CL* produces Epon resin polymers with improved mechanical and electrical properties at temperatures as high as 300° F. After three hours' immersion in boiling water or acetone, glass cloth laminates of Epon resin 828 and Curing Agent CL retained more than 95% of their initial dry flexural strength. And with Curing Agent CL you can use the "B-stage," or pre-curing, process—permitting dry layups and specialized casting techniques.

Your request will bring you a sample of Epon resin 828 and Curing Agent CL for evaluation, as well as a copy of Technical Bulletin SC:54-10. Write for them—today.

Curing Agent CL is Shell Chemical Corporation's name for metaphenylene diamine. We do not manufacture Curing Agent CL. It is available in commercial quantities from E. I. du Pont de Nemours & Company and National Aniline Division, Allied Chemical & Dye Corp.

*A development of Shell Chemical laboratories. Patent applied for.

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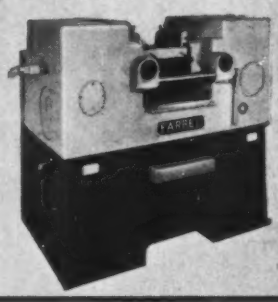
One of these FOUR DESIGNS may be just THE LABORATORY MILL you need

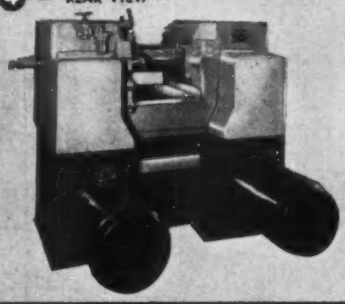
1 — FRONT VIEW

2 — REAR VIEW

3 — FRONT VIEW



4 — REAR VIEW



	Method of Speed Control	No. of Motors	HP Each Motor	Friction Ratio	Roll Speed (RPM) Front	Back
1	Constant	1(AC)	7½	1.4:1	23.5	33
2	Vari-pitch Pulley	1(AC)	7½	1.4:1	13 to 24	18 to 34
3	Vari-pitch Pulleys	2(AC)	5	Variable	20 to 38	18 to 34
4	Variable Voltage	2(DC)	5	Variable	4.5 to 34	6 to 45

Here is a standard, two-roll, 6″ x 13″ laboratory mill, which you can have with four different drive arrangements. One of these should give you exactly the roll speed, or speeds, and friction ratio you need for your experimental work.

Drive may be (1) by single AC motor with mill gearing to give constant roll speed and 1.4:1 friction; (2) by single AC motor driving the rolls through vari-speed sheaves to give a back roll speed range of 18 to 34 RPM and 1.4:1 friction; (3) by two AC motors with vari-speed drives for friction ratios from even speed up to 2.1:1; (4) by two DC motors with variable voltage control for ratios from even speed up to 10:1 friction.

Standard mills have self-contained automatic cascade lubrication, swinging scraper, tilting guides and knee-operated safety trip. Optional features include chrome-plated rolls, extra hand scraper, air-operated scraper, ratchet roll adjustment, and batch-off roll.

Send for further information about this versatile mill. Or, if you prefer, a Farrel-Birmingham engineer will be glad to discuss your laboratory equipment problems with you at any time.

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Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
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Cast Reynolon Film (Polyvinyl Alcohol, Polyvinyl Chloride) Extruded Reynolon Film (Polyethylene) treated or untreated for printing. Available through sales offices in New York, Chicago, Los Angeles.

In addition to our line of Reynolon Plastic Film we offer a Technical Product Development Service. Working with manufacturers, we assist in the design of new products and in the redesign of existing products.

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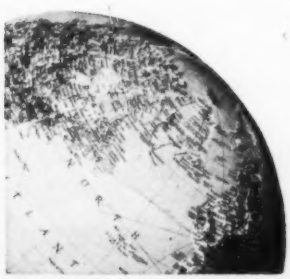

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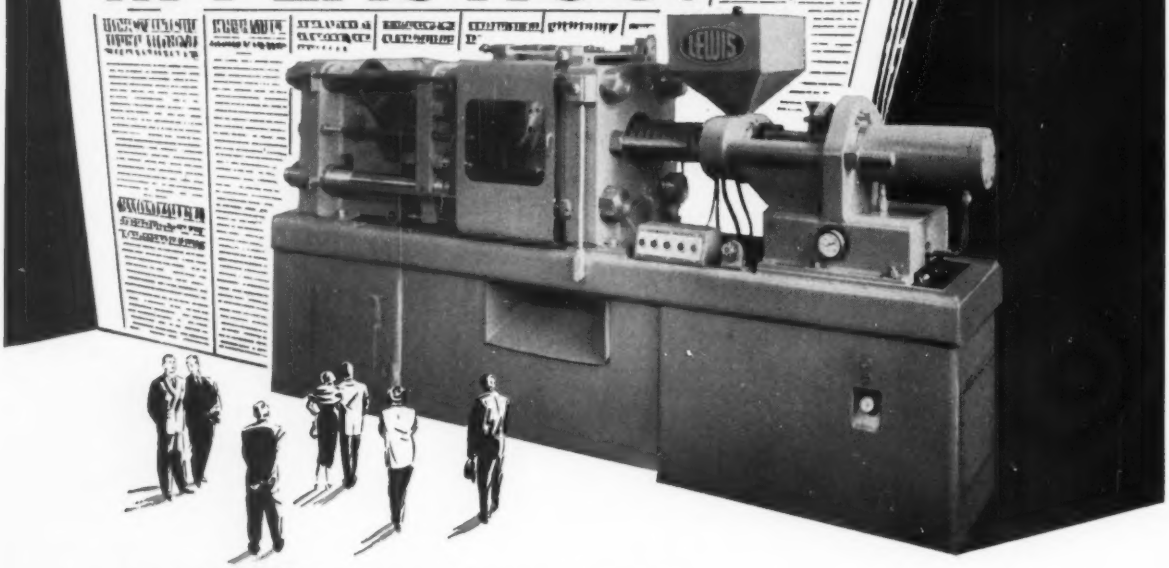
THE BIGGEST NEWS IN PLASTICS!



The LEWIS "6" Injection Molding Machine

HERE'S WHY:

INCREASED CAPACITY . . . The Model "6" will plasticize up to 60 pounds of material per hour . . . mold 7-ounce shots of polystryene at the rate of 2½ per minute.

NEW CLAMPING MECHANISM . . . The exclusive LEWIS "HYDRA-LOCK", the most powerful mold clamp available, develops a 200-ton clamping pressure in tenths of a second.

ASSURED ECONOMY . . . Intricate parts formerly made on much larger machines can now be produced by the Model "6" at a fraction of initial and normal operating cost.

MAXIMUM SAFETY . . . Mold clamping device features over-center toggle mechanism . . . safety interlocks on gate . . . and emergency stop for positive safety.

In addition, injection pressures up to 15,000 psi . . . a compensating feed mechanism . . . automatic molding cycle . . . large platens . . . fingertip controls . . . and minimum maintenance combine to make the biggest news in plastics . . . THE LEWIS "6" INJECTION MOLDING MACHINE.

Write today for Bulletin 102.

LEWIS

THE LEWIS WELDING AND ENGINEERING CORPORATION

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PARAPLEX P-431 Resin

Makes These Panels Light, Rugged, Durable

The manufacturer of these panels chose PARAPLEX P-431 resin because it is easy to handle, has good color and resistance to discoloration by ultraviolet light, and is uniform from batch to batch. He also wanted the advantages of Rohm & Haas technical service.

Corrugated panels of PARAPLEX P-431 and glass fiber have other features, too. They are light, weather-resistant, translucent, strong, and durable. They can be worked with ordinary hand tools—are easy to drill, saw, or nail. They have good dimensional stability, high impact strength, and an excellent strength-to-weight ratio. But why stop with panels?

PARAPLEX resins lend themselves to a multitude of reinforced plastic products. The resins are available in a variety of grades, each designed to fit a wide range of applications. By blending one with another, special properties may be obtained which extend the range of each resin's usefulness. For example, a product can be made soft or tough, rigid or flexible. Moreover, PARAPLEX resins are adaptable to a variety of production schedules and techniques. A phone call or letter will bring you further information.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

PARAPLEX *is a trade-mark Reg. U.S. Pat. Off. and in principal foreign countries.*

Point for point...

CYCOLAC

A *New* HIGH-IMPACT THERMOPLASTIC RESIN

is your trump production card

1. Single uniform resin, permanently thermoplastic permitting fast molding, calendering and extruding.
2. Free from nerve or shrinkage, permitting accurate calendering and extruding.
3. High in impact-resistance and heat-distortion temperatures, low in brittle point.
4. Capable of being colored to about any opaque shade.
5. Capable of being solvent or heat-welded; can be machined much like other rigid thermoplastics.
6. Economical to form from press polished sheets by vacuum, air pressure, or mechanical methods over inexpensive molds of wood, plaster, aluminum, etc.
7. Very light — Sp. Gr. 1.01. Dimensionally stable, readily injection-molded.
8. Resistant to many oils, solvents and corrosive chemicals.
9. Soluble in selected solvents, for potential coatings applications.
10. Characterized by excellent electrical properties.

Marbon

MARBON CORP.

GARY, INDIANA

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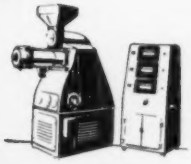
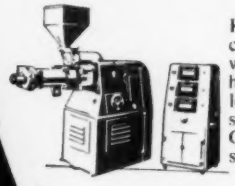
QUALITY EXTRUSIONS

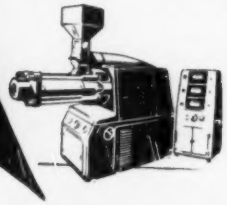
on WINDSOR high production extruders



R.C.65. This is a twin-screw variable speed extrusion and compounding machine with an hourly output of 65 lb. plus. An automatic feeding device for metering plastic material to the extrusion screws is incorporated and automatic heating regulation is provided.



R.C.100. The R.C.100 twin-screw machine is a medium capacity extruder with a nominal output of 100 lb. per hour and will operate continuously over long periods, producing tubes, rods and sections in thermoplastic materials. Coated cables, rods and tubes are standard jobs.



R.C.200. Three screws provide this heavy duty machine with exceptional mixing powers. With a nominal output of 200 lb. per hour, constant extrusion pressures, and trouble free operation, it satisfies the demand for a multi-screw machine of really high output.

The photographs on this page are by courtesy of Messrs. Wallington Weston & Co., Ltd., Frome, Somerset, England. The R.C.100 extruding 6" outside diameter pipe from "Fromoplas HT" material.

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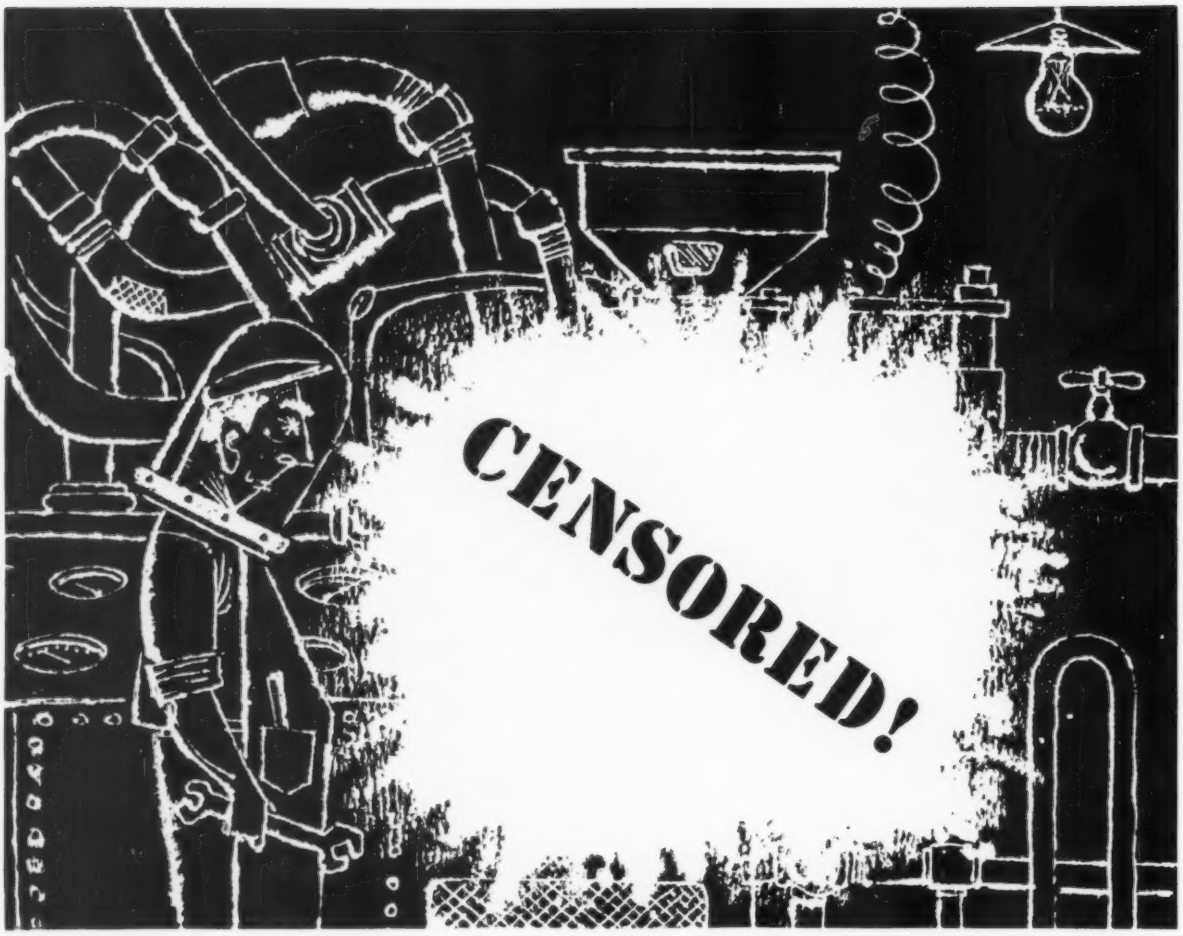

This month Boonton wanted to bring you a picture of the Fabulous Atomic Moldatron we have on order from the Atomic Super Energy Commission, but we couldn't get permission to show it.

Worse than that, we have just been told our Fabulous Atomic Moldatron won't be ready for delivery for at least five years. In the meantime, we will be compelled to continue molding the better known plastic materials by the same conventional methods—injection, compression, transfer and plunger—by which we have been pleasing customers for the past thirty years.

We will still have our headaches . . . you will still get your moldings on time; things aren't as bad as they seem, are they?

BOONTON MOLDING CO.

BOONTON, NEW JERSEY

NEW YORK OFFICE—CHANIN BUILDING, 122 EAST 42ND STREET, OXFORD 7-0155

Announcing a new Koppers plastic—"Fibertuff" Polystyrene

It's reinforced with glass fibres yet it is easy to mold

● New "Fibertuff" Polystyrene contains thousands of glass fibers. When the polystyrene is heated and injected into molds, these fibers break up, so that the compound flows smoothly through the injection nozzle—to fill the entire mold. When the material sets, the glass fibers reinforce the polystyrene. As a result "Fibertuff" Polystyrene products are strong, rigid and maintain full mold dimensions.

"Fibertuff" Polystyrene is molded like any other polystyrene. Special injection nozzles and molds are not required—and scrap can be ground up and re-used.

This new reinforced thermoplastic is finding many uses. One molder, for example, is using "Fibertuff" Polystyrene to manufacture tape recorder reels. The new polystyrene reels weigh 50% less than the metal one previously in use. They do not warp or dent, and will not scrape the tape edges. "Fibertuff" Polystyrene can be used in heater fans, battery cases and radio cabinets—wherever strength, heat resistance, and dimensional stability are important.

For more detailed information about the properties and molding characteristics of "Fibertuff" Polystyrene write to us today.

Koppers Plastics Make Many Products Better and Many Better Products Possible.

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KOPPERS COMPANY, INC., Chemical Division, Dept. MP-74, Pittsburgh 19, Pennsylvania

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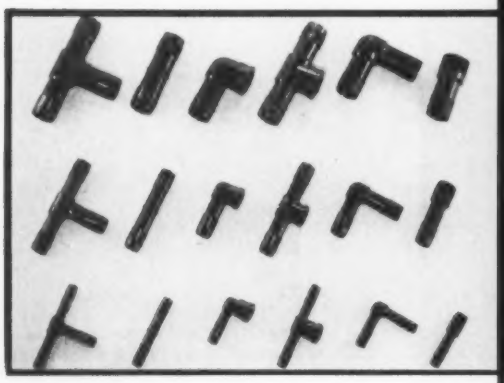
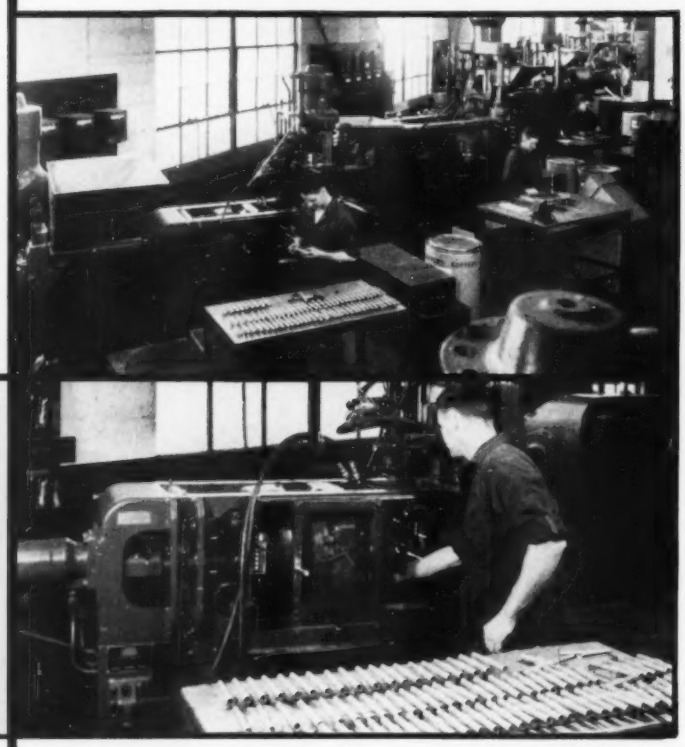
5 reasons why R&K Tool prefers molding

PIPE FITTINGS on LESTERS

R & K Tool & Die Co. (another all-Lester shop) is molding plastic fittings for polyethylene pipe applications for Industrial Plastic Fittings Co. R. A. Rybak, Chief Engineer for R & K says, "We depend on Lesters; not only for the machine features, but also because of the excellent cooperation we get from the company in solving specific problems."





GENEROUS PLATEN AREA . . . . . Because of the cam action, two small pipe "T's" require a 24-1/2" x 26" clearance when the slides are open. Such a mold can still be run in an 8 ounce Lester because of its big platen area.

CENTRAL DIE HEIGHT ADJUSTMENT . . . With 36 different fittings to stock, rapid mold changing is a regular requirement. Down-time for mold changes is reduced to an absolute minimum, with single hand crank die height adjustment.

METERED TOGGLE ACTION . . . . . Complex horn molds demand smooth toggle action—Lester's can give uniformly slow movement, metered for the full stroke, opening and closing.

CUSHIONED MOLD ACTION . . . . . Cushioned mold closing and cushioned ejection protects the precision threaded inserts from damage.

BETTER PLASTICIZING . . . . . Thorough plasticizing from the internally heated cylinder helps considerably in producing strong plastic pipe fittings.

LESTER INJECTION MOLDING MACHINES

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New York . . . . Steven F. Kroudl
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DURITE GP-102 is *really* versatile. Whether your moldings are large or small . . . intricate or simple . . . thin-walled or heavy-sectioned . . . this new compound will impress you by its performance.

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Phenolic Molding Compounds • Abrasive and Frictional Bonding • Resins • Molding and Specialty Resins • Lamp Basing Cements

Today's growing use of fiber glass reinforcements in plastics molding brings up problems on every new molding job.

That's why it's extremely wise to call in your local Pittsburgh Fiber Glass representative for his recommendations on the type and size of fiber glass you should use on any particular molding job. While you know your molding problems best, he and the technical staff at Pittsburgh can contribute technical information on the fiber glass reinforcement that will best suit your individual molding job.

There's over 70 years of glass-making "know-how" behind PPG Fiber Glass and its manufacture. This know-how has meant new high quality in Roving, Chopped Strands and Yarns bearing the Pittsburgh label. Why not get the complete details on Pittsburgh Fiber Glass reinforcements and technical service today? Simply contact our executive offices or district sales offices in Chicago, Cincinnati, Cleveland, Detroit, New York or Washington. Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.

Write our executive offices today for the new folder describing Pittsburgh Fiber Glass reinforcements.

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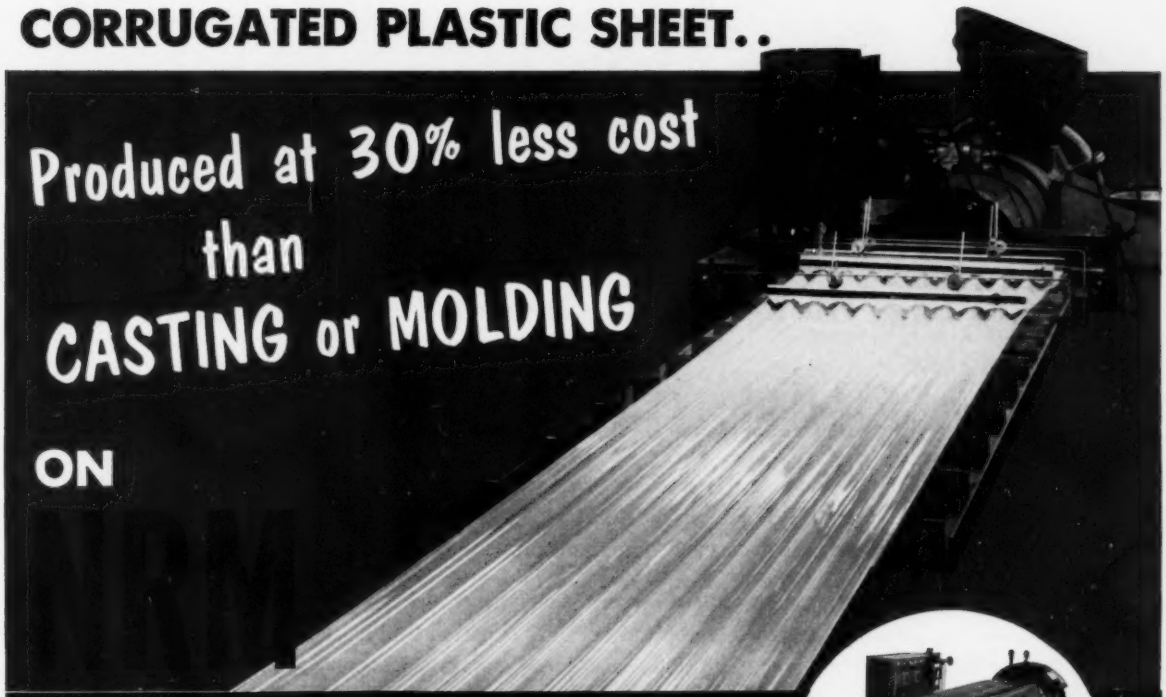
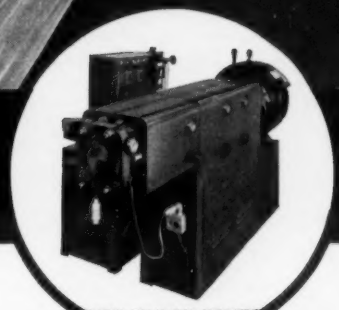
CORRUGATED PLASTIC SHEET..

Produced at 30% less cost than CASTING or MOLDING ON



EXTRUDERS



NRM 3½" OIL-HEATED THERMOPLASTICS EXTRUDER

Conventional methods of molding or casting corrugated Acrylic sheet required selling prices normally beyond the typical consumer. The manufacturer turned to Southern Plastics Company, Columbia, S. C., for help. "Is there some way to produce this at substantially less cost," they asked?

Southern Plastics' engineers went to work on the problem. The question *they* asked was "Why not extrude?" . . . The photo shows the Acrylic sheet being produced on an NRM 3½" Extruder at the Southern Plastics Company. The complete success of the project is best attested by the substantial reduction the customer was able to make in the price of the sheet.

In discussing the project, Mr. Lindau, President of Southern Plastics Company stated: "Our NRM Extruders played a big part in reducing costs all the way along. We find that we can both *develop* and produce faster and more precisely on our NRM Equipment, than on other extruders in service."

Perhaps some of *your* cast or molded products can be produced at *less cost* by extrusion . . . It's certainly worth investigating, for — as in the case of the Acrylic sheet — such possibilities usually do not suggest themselves. And here's where *NRM* can help . . . Our technical staff will be glad to work with you on any question regarding thermoplastic extrusions or to advise on equipment best suiting your production problems.

From the beginning of the plastics extrusion industry, NRM has consistently furnished producers with processing machinery of most practical design, and worked closely with the industry on most effective use of it. We invite *you* to take advantage of this experience to help work out your plastics problems or ideas. Write today.

2246

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London's Oldest Station

Installs World's Most Modern Lighting System

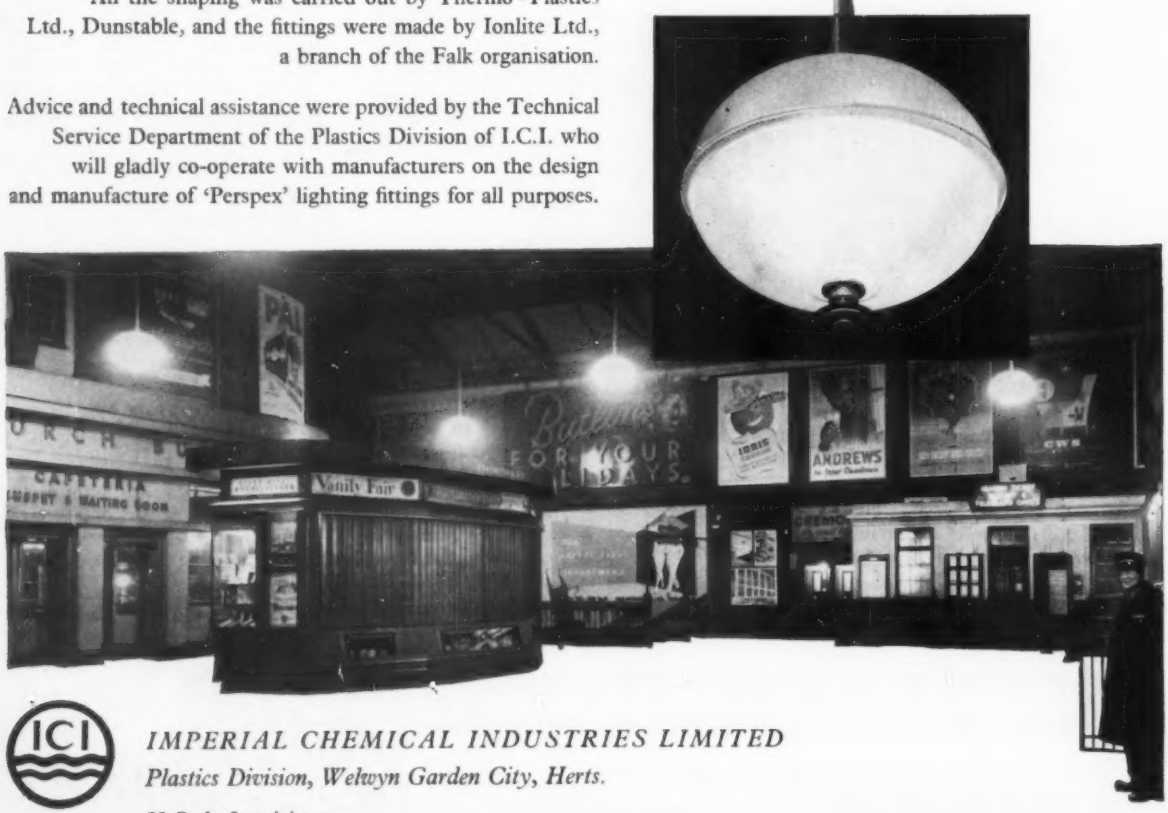
in 'PERSPEX'

Fenchurch Street Station, the oldest in the City of London, has installed cold-cathode fluorescent tubes completely enclosed in opal 'Perspex' acrylic diffusers. These ultra-modern fittings are corrosion-resistant, tough, and very easily cleaned—important practical advantages to British Railways.

The general lighting units consist of two 'Perspex' shapings 37 inches in diameter, the upper in opal 'Perspex' 040 and the lower 030 designed and fabricated so as to give a well balanced distribution of light. The platform fittings are 8 feet long, with diffusers shaped from opal 'Perspex' 030.

All the shaping was carried out by Thermo-Plastics Ltd., Dunstable, and the fittings were made by Ionlite Ltd., a branch of the Falk organisation.

Advice and technical assistance were provided by the Technical Service Department of the Plastics Division of I.C.I. who will gladly co-operate with manufacturers on the design and manufacture of 'Perspex' lighting fittings for all purposes.



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MODERN PLASTICS ENCYCLOPEDIA ISSUE

Publication Date: September 1961

WHAT IT IS

The Modern Plastics Encyclopedia Issue is published annually in September as the thirteenth issue of Modern Plastics magazine . . . and goes to all Modern Plastics subscribers. It's the accepted "workbook" of the plastics field . . . bound in handsome hard covers . . . carries the advertising of all the field's leading suppliers . . . answers practically all questions relating to plastics: materials and their properties, their applications, production methods, processing equipment and machinery . . . contains the only complete Buyers' Directory in the field . . . is completely revised each year to cover all new developments and changes.

WHO READS IT?

The new edition will have the same circulation as Modern Plastics magazine. Currently the figure stands at 22,185—an all time high.

This circulation covers not only the plastics materials and processing industry but also the major buying influences in the many plastics-using industries. Specifically, it carries your sales message to:

1. **Plastics materials suppliers.**
2. **Molders, mold-makers, fabricators, laminators, extruders, and processors of film, sheeting and reinforced plastics.**
3. **The manufacturing companies primarily engaged in other industries who either (a) buy finished plastics parts and products; (b) buy semi-finished plastics products and do part of the finishing themselves; (c) mold or fabricate their own plastics parts or products in "captive" plastics plants.**

WHAT DO THESE READERS BUY?

A glance through this issue of the magazine will give you a fairly good cross-section of the kinds of materials, supplies, services and equipment that users of plastics buy. Basic purchases include all of the following:

CHEMICALS AND MATERIALS

adhesives	organosols
coatings	solvents
extenders	colorants
plastisols	plasticizers
stabilizers	laminates
dyes	saturating papers
glass fibre	wetting agents
synthetic resins	mold steels
fillers	lubricants

EQUIPMENT

hydraulic systems	scales
granulators	drills
buffers & polishers	extruders
mixers	drill presses
pyrometers	accumulators
cutting tools	heat sealers
lathes	mills
grinders	embossers
molding presses	timers
calenders	duplicators
slitters	control instruments
hobbing presses	motors

SERVICES

industrial designing	deep drawing
assembling	postforming
hobbing	fabricating
plating	embossing
molding	decorating
laminating	mold making

DO THE READERS USE IT?

Last year John T. Fosdick Associates, a prominent research organization, conducted a nation-wide field study among a cross-section of readers in 16 cities. Their report says:

93% keep the Encyclopedia "near at hand."
6% use it almost every day.
13% use it at least twice each week.
30% use it at least every other week.
87% refer to it at least every other month.

WHAT KIND OF ADS WORK BEST?

Readers of Modern Plastics Encyclopedia Issue want detailed, usable facts, not broad claims or fancy artwork. When they turn to the Encyclopedia Issue, they're getting down to *"brass tacks"* —comparing, evaluating, making buying selections.

Here are characteristic reader comments as reported by John T. Fosdick Associates:

" . . . need more technical data"
" . . . give an idea of price range"
" . . . more data on actual applications"
" . . . give more complete physical and chemical properties"
" . . . be specific in performance of machinery"
" . . . too many ads have incomplete data"
" . . . advertising is too general"

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1. ☐ Please send me full details about the Encyclopedia Issue.
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SPACE	BASIC RATE*
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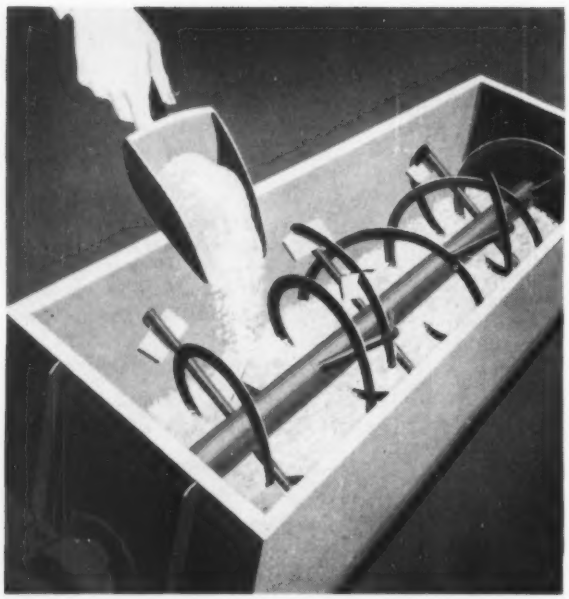
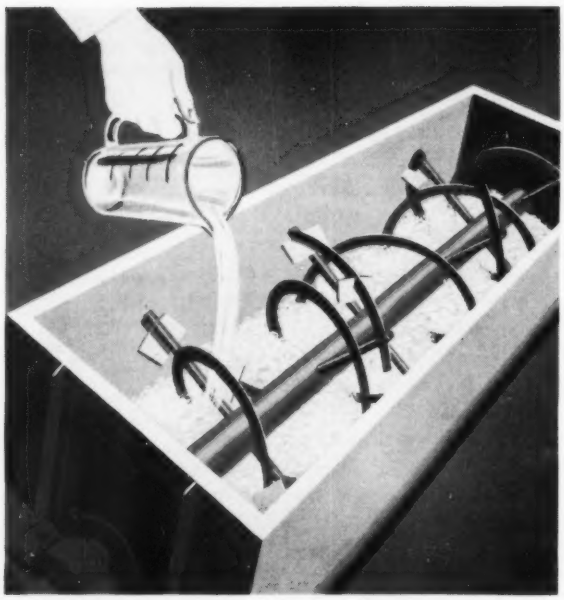
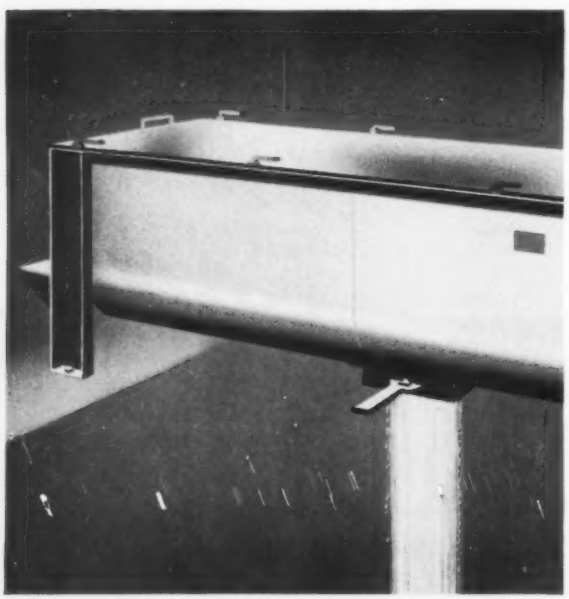


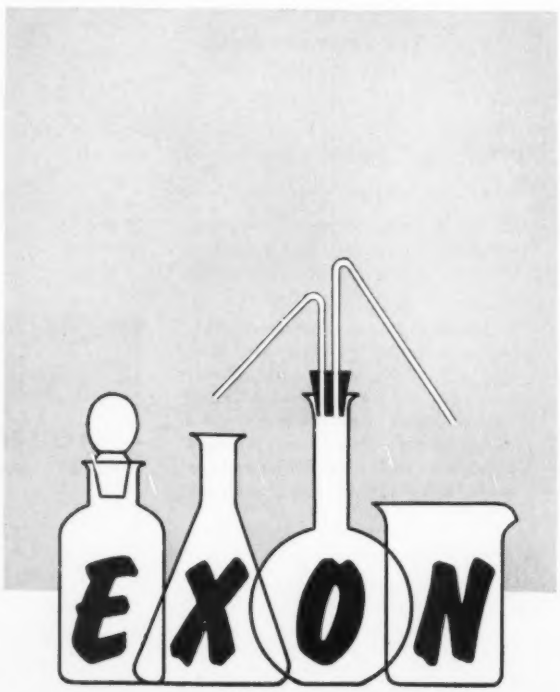
1. In preparing a sample formulation, picture shows Exon 500 resin as it is shipped by Firestone. It is in white powder form—has excellent dry blending characteristics.



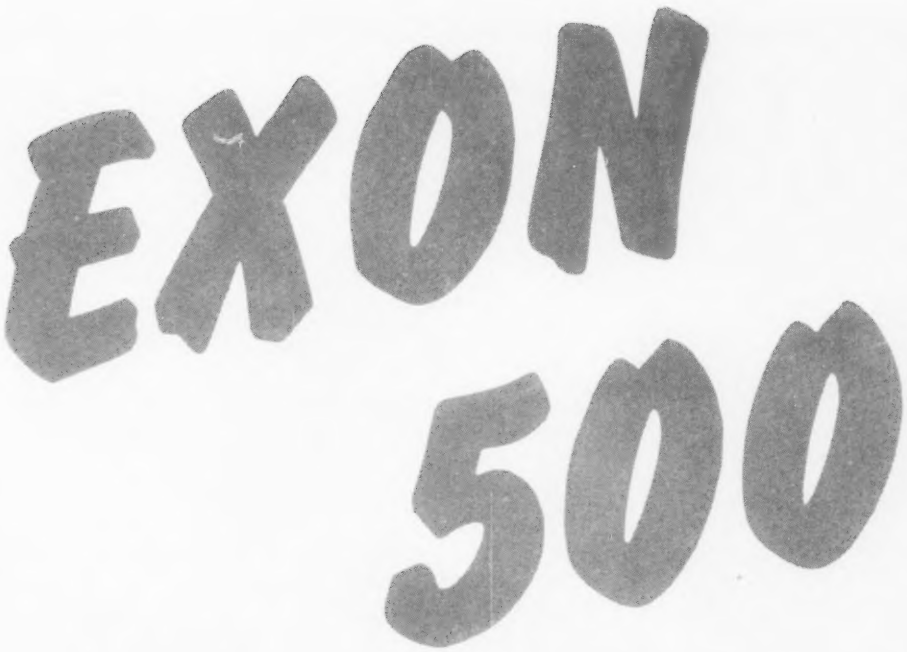
2. Blending liquid plasticizer with Exon 500. Each of the controlled particles of Exon 500 act as a tiny sponge, quickly and completely absorbing liquid ingredients.



3. Result! A complete Exon 500 resin compound ready for the hopper. The formulation is free-flowing, lump free. Milling and pelletizing is never necessary.



reduce costs...
DRY BLEND resin...



FIRESTONE is now serving the extrusion industry with an improved EXON 500 resin. Wire and cable manufacturers in particular can avail themselves of a faster, more economical operation, a simplified, flexible inventory — through the use of Exon 500.

EXON 500 has been improved to impart excellent dry blending characteristics to compounds —without compromising its outstanding physical and electrical properties.

EXON 500 speeds blending cycles. It readily absorbs plasticizer in a fast, uniform manner. The controlled particles inherently assure the flowability of the final formulation.

EXON 500 — when used as a dry blending resin in compounding, eliminates the need for milling and pelletizing. Finished formulation is a fluid-like, free-flowing powder ready for the hopper with no lumps, cakes or agglomerates.

EXON 500 simplifies and decreases inventory by allowing the processor a greater flexibility of operation.

Complete details for the use of Exon 500 resin in electrical and mechanical compounds—plus suggestions and technical assistance in their development are available on request.

CHEMICAL SALES DIVISION

Firestone Plastics Company, Pottstown, Pa., Dept. 2 C
Division of The Firestone Tire & Rubber Co.

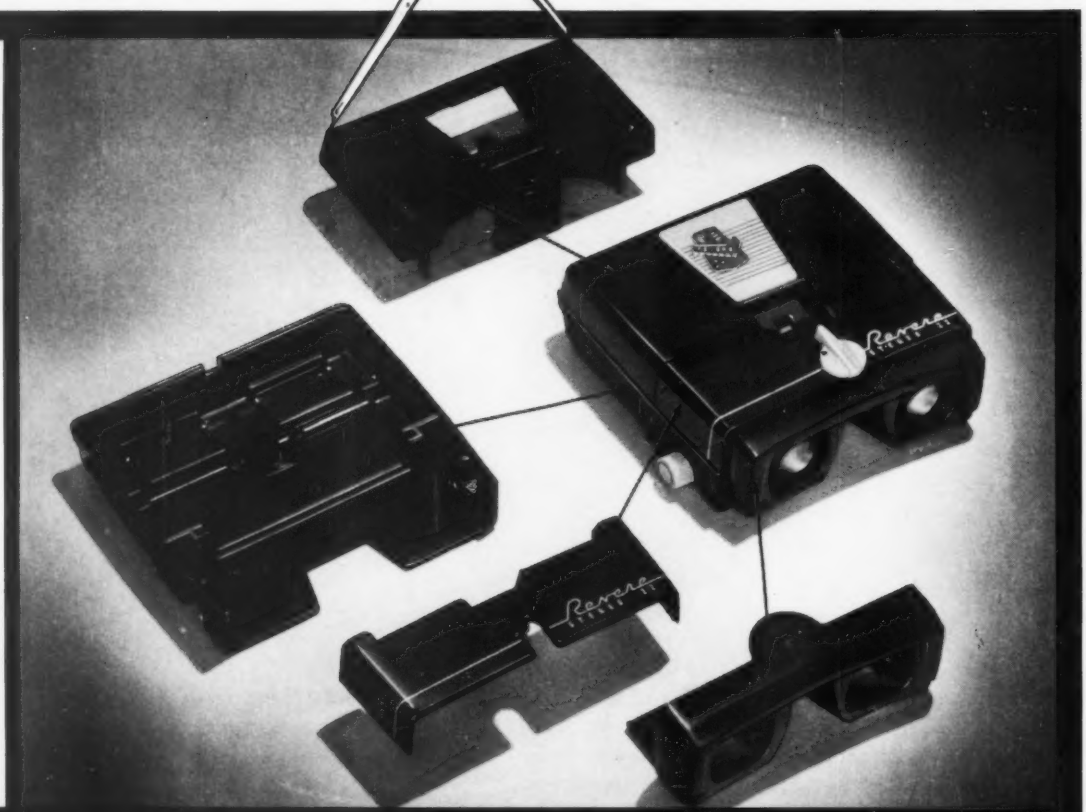
PROPERTIES OF *EXON 500*

Physical Properties	
Form	White Powder
Specific Gravity	1.40
Average Bulking Density, gm./c.c.	0.50
Average Relative Viscosity	2.55
Approximate Electrical Properties	
Insulation Resistance (*15.6°C*) (*Megohms/1000 ft.*)	4500
Dielectric Constant (*23°C*) (*SIC—one day*)	7
Dielectric Strength, KV. (*in oil at 23°C*)	35-37
Power Factor (*60 cycles at 23°C*)	0.099-0.100

REVERE STEREO VIEWER . . .

precision molded

IN VOLUME PRODUCTION



by RICHARDSON

SIX PLANTS

This handsome plastic case for the Revere Stereo Viewer, produced by Richardson, required the molding of four intricate parts. Each part had to be held to close tolerances for easy assembly and good appearance. Special care was needed to prevent warpage, and also to produce a smooth lustrous surface. The Revere Camera Company was extremely pleased with the precision and beauty of the finished job.

Richardson specializes in plastics jobs of this type—jobs which require volume production of precision moldings of the highest quality. Why don't you consult Richardson on your difficult plastics jobs?

Send for Bulletin, "Facts About Plastics"

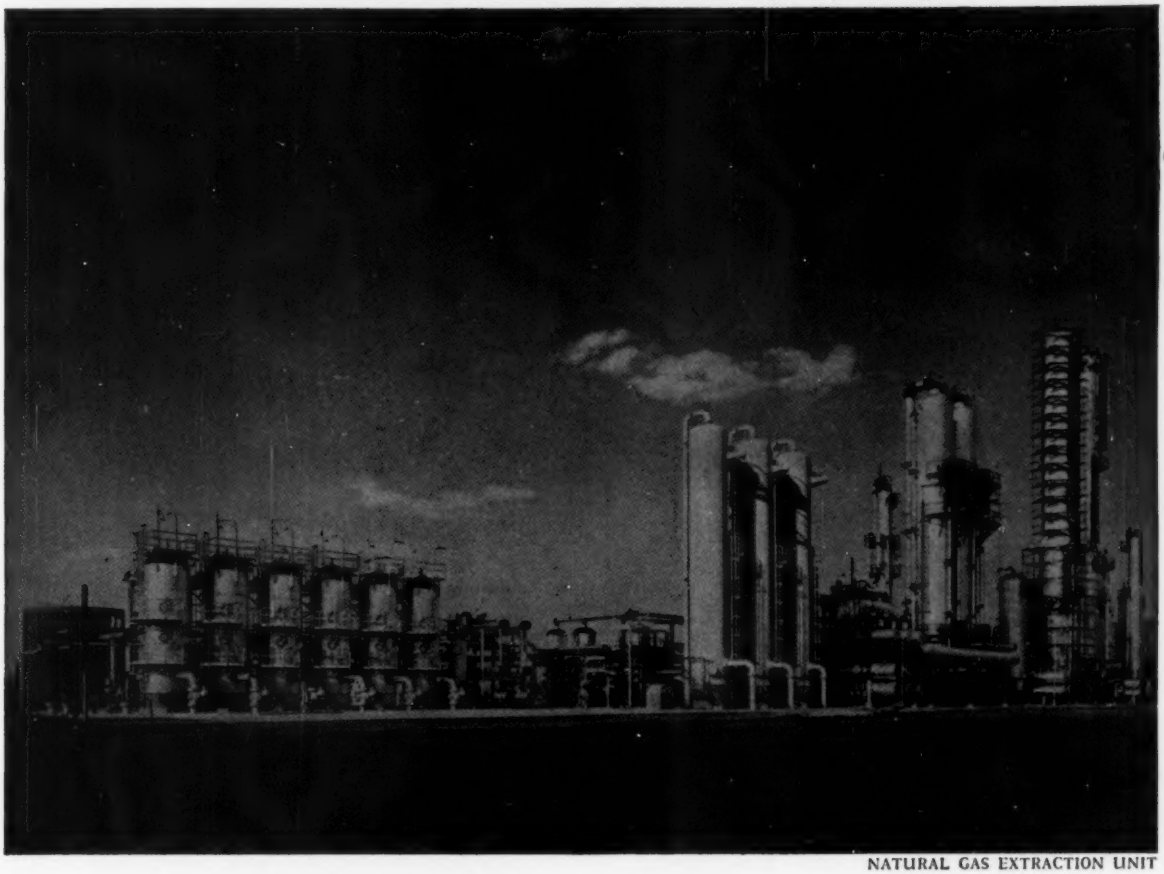
The RICHARDSON COMPANY

FOUNDED 1858

2789-A Lake St., Melrose Park, Illinois (Chicago District)

SALES OFFICES IN PRINCIPAL CITIES

Petro starts construction work on polyethylene plant



NATURAL GAS EXTRACTION UNIT

The emergence of National Petro-Chemicals Corporation in 1955 as a large scale polyethylene producer will be a natural outgrowth of the entire Petro operation. From pipeline gas to polymer, the plant at Tuscola, Illinois will be an integrated unit processing ethane to ethylene to polyethylene. Only in this way can continuity of supply be assured, and quality controlled in full.

The polyethylene plant is being constructed by The M. W. Kellogg Company, and is based on a process developed by ICI and modified by Petro to fit specific conditions. Recycling of gases is eliminated to insure a product of the highest quality.

A new process control, product application and research laboratory is also under construction at Tuscola to augment present knowledge and to improve product and process after production gets underway. These facilities are designed for prompt, efficient service to polyethylene users in their processing problems.

This new product, "Petrothene", will be available in June, 1955. From the centrally located plant, immediate shipments can be made to any part of the country —direct by truck or rail. Bulk shipments will also be handled.

Because Petro believes in the future of polyethylene, the unit has been geared to a three to four-fold production increase. As new uses are developed, this additional production will be needed, and Petro will be there to serve your expanding markets.

"PETROTHENE"... THE POLYETHYLENE OF TOMORROW

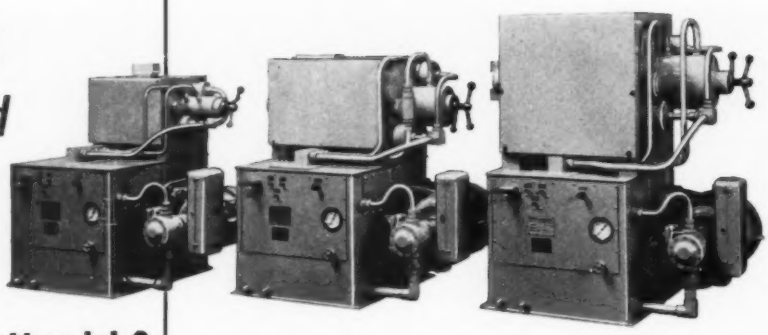
NATIONAL PETRO CHEMICALS

CORPORATION

A joint enterprise of National Distillers Products Corporation and Panhandle Eastern Pipeline Company

120 BROADWAY, NEW YORK 5, N. Y.

Why struggle along with *old fashioned* preformers when Bipel pelleters do so much of a better job?



left to right:

12 tons 35 tons 70 tons

Compression molders who have long sought the advantages of *hydraulic* preforming combined with the rapidity of mechanical preforming and with minimum need for maintenance will find what they have been looking for in Bipel Horizontal Hydraulic Pelleters. These machines simplify the job of making sound preforms at high speeds.

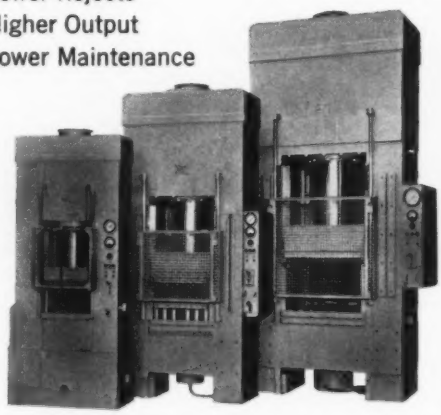
Bipel Pelleters use the main ram for compressing the powder only; filling and ejecting depend on rapid movements of the die and hopper. Thus, the powder is compressed not by a blow as in mechanical preforming, but by a *steady squeeze* that can be applied as long as needed to compact the powder. The dwell and the pressure can be accurately set for any particular powder in a matter of a few seconds. Even difficult powders can usually be preformed successfully.

Moreover, no moving parts come between the punches, so the machine cannot suffer damage. The die is completely free during the squeeze, which is equivalent to applying pressure on both punches. As a result pellet density is always uniform, even when square, rectangular or ring-shaped punches are used.

Bipel Hydraulic Pelleters are completely self-contained with their own motors and pumps (shop air supply is used for the controls). Since pressure builds up only during squeeze and ejection, the motors idle most of the time. Power consumption is small.

AUTO-CONTROL COMPRESSION / TRANSFER PRESSES

- Fewer Rejects
- Higher Output
- Lower Maintenance



Type 40	Type 100	Type 200
pressure range 20-60 tons	pressure range 50-150 tons	pressure range 100-300 tons

Auto-Control enables these presses, once set, to reproduce automatically any conceivable molding technique, including "breathing" and "dwelling"; the operator simply presses a button to start the cycle.

Complete information on pelleters and on Bipel "auto control" presses can be obtained in the United States from:

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MODERN Automatic PLASTIC INJECTION MOLDING MACHINES

Before you buy any plastic molding machine, either fully automatic or hand operated, we urge you to investigate the features of the MOSLO line. These are the machines that are setting new and higher standards of quality production for many types of molding operations. They have the effective controls, rugged construction, reliability and speed that make profitable production possible, year after year, in all lines of the plastic molding industry. Savings extend to materials and mold cost as well as productive time.

We invite your inquiry. Write for complete information, stating your requirements. We will be pleased to arrange a demonstration.

MODEL 73

- 2 oz. injection capacity per shot
- 1200 cycles per hour
- 25 lbs. per hr. *plus* plasticizing capacity
- Molds 20 square inches of area *plus*
- Material hopper capacity—40 lbs.
- Mold opening 6"

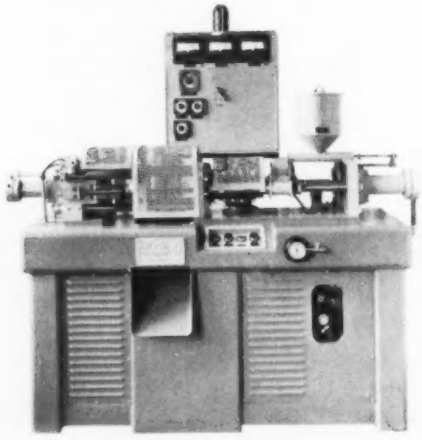
MODEL 75

- 2-3 oz. injection capacity per shot
- 740 cycles per hour
- 50 lbs. per hr. plasticizing capacity
- Molds 40 square in. of area
- 50 lbs. capacity of material hopper

This machine is available with mold arrangement and cycle to fit requirements of mold opening from 8 to 16 inches.

MODEL 80

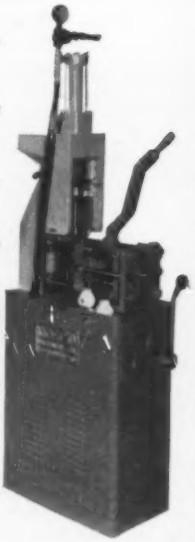
- 3-4 oz. injection capacity per shot
- 950 cycles per hour (dry run)
- 75 lbs. per hr. plasticizing capacity
- Molds 60 sq. inches of area
- 60 lbs. capacity of material hopper
- Mold opening 8"



MODELS 73 - 75 - 80

MODEL HC 75
HYDRAULIC MINIJECTOR

- ¾ oz. injection capacity per shot
- Mold size 6"x5"x 5⅛"
- 5.5 lbs. per hr. plasticizing capacity
- Molds 6 sq. in. of area
- 4 lbs. capacity of material hopper
- Vickers hydraulic pump equipment
- Ideal for small parts and die tryout

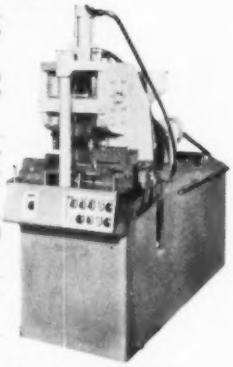


¾ OUNCE HAND OPERATED MINIJECTOR

- Ideal for schools, laboratories, die tryout and for making small parts
- ¾ oz. injection capacity per shot
- Mold size 6½"x2"x 2⅜"
- 4 lbs. capacity of material hopper
- Thermostatic control up to operating temperature 100° to 600°
- Available either as a bench model or floor model

DUPLIMATIC MINIJECTOR

- 2½ oz. injection capacity per shot
- 450 cycles per hour (dry run)
- 35 lbs. plasticizing capacity of material cylinder
- 20 sq. in. maximum mold casting area
- 25 lbs. capacity of material hopper
- Mold opening 2½"



This is the machine that has become standard in electrical industry for insert work. Especially suited for high speed production of molded cord plugs, switch parts, etc.

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Fresh...and ready for anything!

Fresh . . . because we have concentrated on two resins thus eliminating aging and storage problems. By producing only two resins we maintain a constant and rapid turnover in inventory. By using these two you can streamline your own inventory and be assured of having fresh resins at hand.

Ready for anything . . . because in these resins, at a standard price we are combining high reactivity, good wetting properties and light stability. By blending versatile, rigid Glykon R-100 with its companion resin flexible Glykon F-600 you can meet practically the whole range of fabricating requirements.

For more information fill out the coupon below or write to General Tire & Rubber Company, Chemical Division, 1708 Englewood Avenue, Akron 9, Ohio.

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TITANOX titanium dioxide pigments are compatible with all types of rubber and plastics. These strongest of white pigments add quality by imparting whiteness and maximum brightness and opacity to white or tinted products while maintaining natural strength and life.

Consult with our Technical Service Department for the solution to any rubber or plastic pigmentation problem you may have. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; Atlanta 2; Boston 6; Chicago 3; Cleveland 15; Los Angeles 22; Philadelphia 3; Pittsburgh 12; Portland 9, Ore.; San Francisco 7. In Canada: Canadian Titanium Pigments Limited, Montreal 2; Toronto 1.

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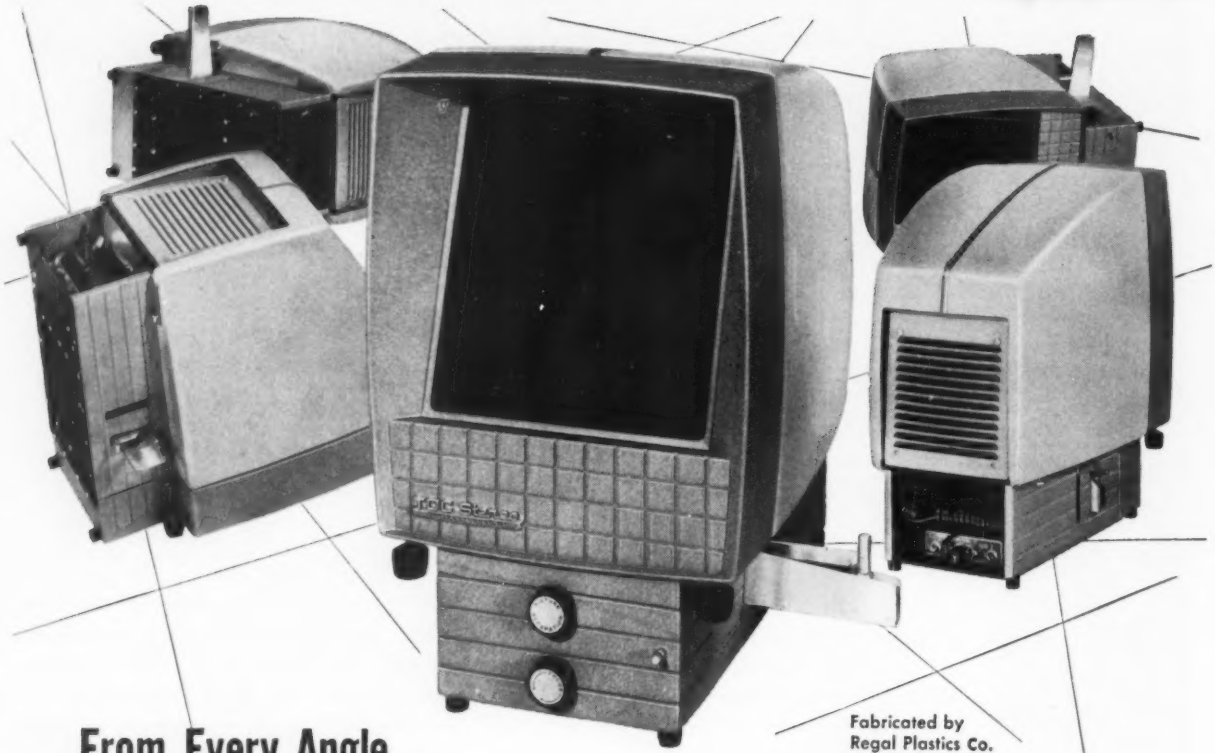

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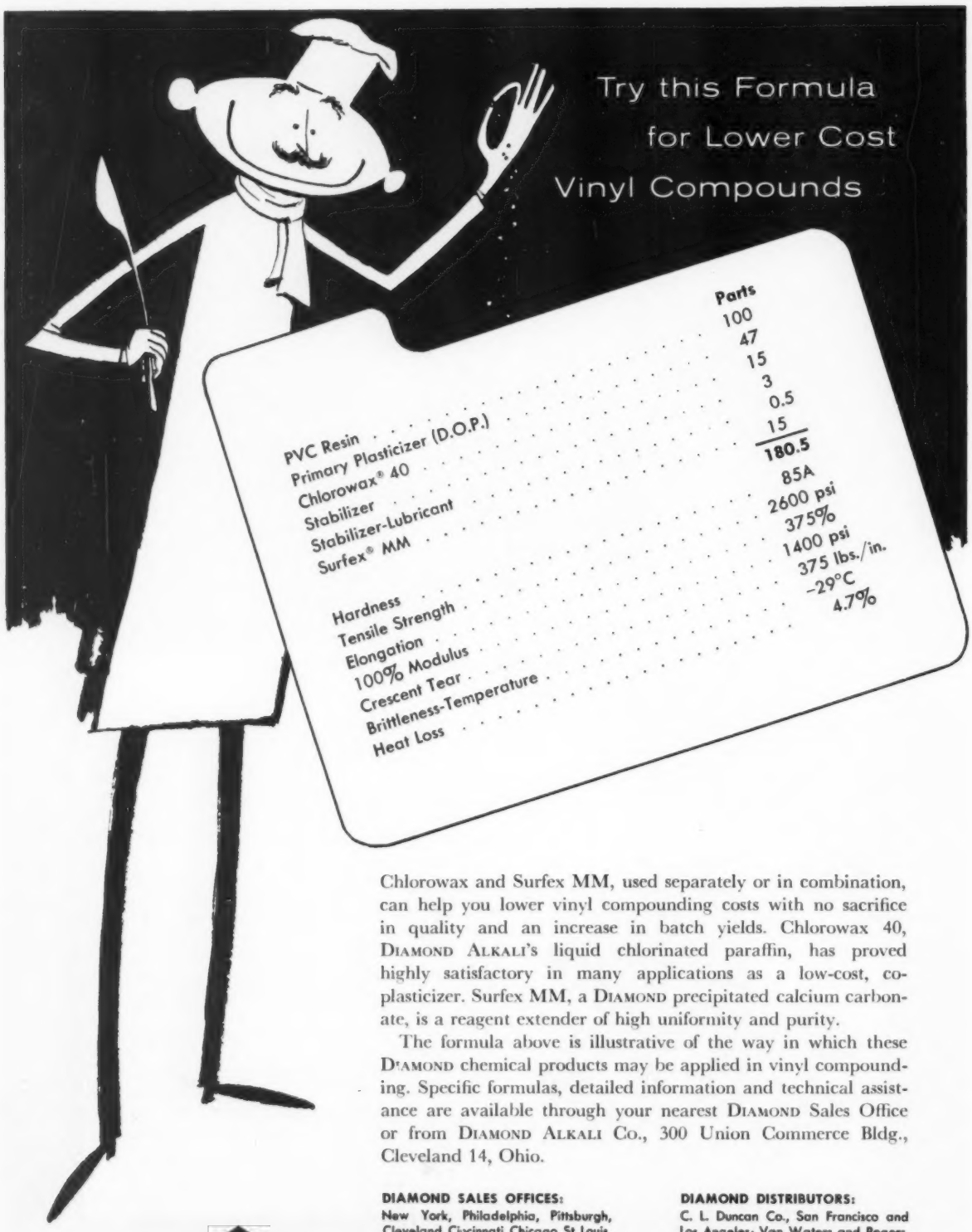

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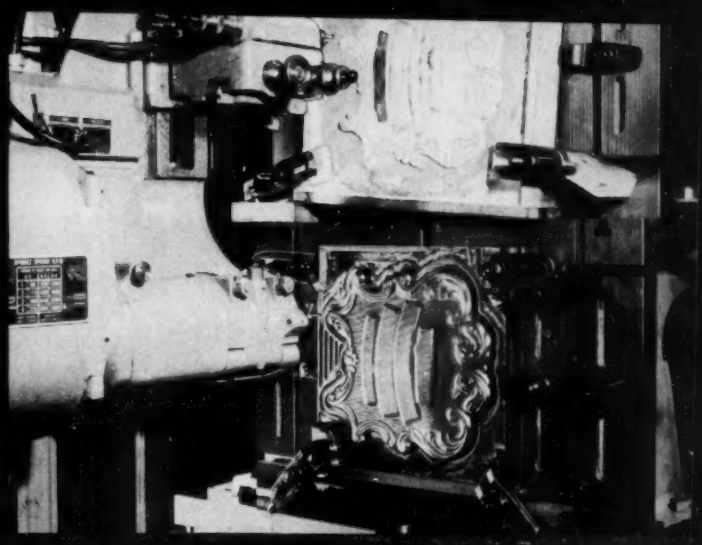

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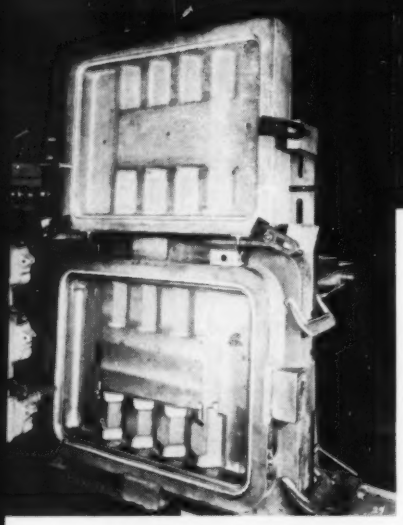
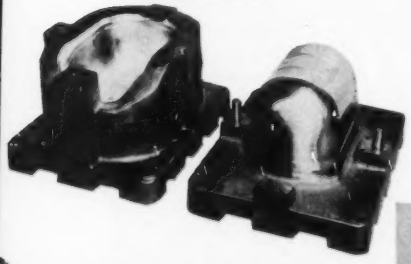


"Kellering" makes easy work of producing this big, complex meehanite cavity-half of a fiber-glass mold.

Photo courtesy of MPM Inc., Cleveland, Ohio



This mold and force for a fiber-glass welder's helmet, duplicated from full models, included a deep cavity with heavy stock removal.

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DILECTO HAS HIGH MECHANICAL STRENGTH

Mechanical strength is frequently an important determining factor in the selection of an insulating material. Insulating parts used in large electrical power equipment are frequently bulky. The high mechanical strength of Dilecto helps reduce size-dimensions of insulating parts without danger of failure. Instruments, meters and small motors frequently require very small insulating parts which must withstand comparatively large mechanical stresses. Insulation for use in high frequency circuits should have a minimum bulk factor for minimum dielectric losses. Dilecto fulfills these requirements with a combination of high mechanical strength and low loss factor, characteristic of the better C-D-F electrical grades.

So C-D-F selects for your Dilecto insulation grade the correct, highest quality base material, paper, cotton, nylon, glass. These are used in combination with improved penetrating resins: Improved Phenolic, New Melamine, New Silicone, New Teflon, all synthetic, well polymerized resins.

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Why does Dilecto combine so well mechanical strength with dielectric strength and dimensional stability? Because Dilecto is almost homogeneous, a true blend of resin and base.

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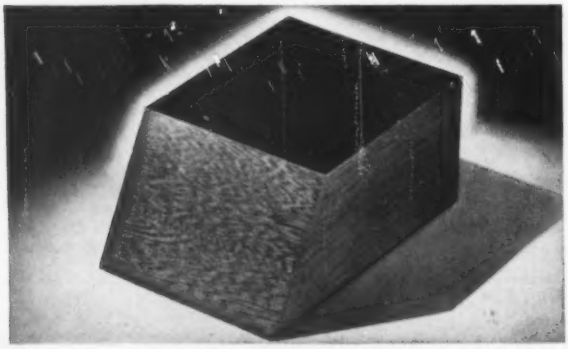
A poor laminate absorbs moisture at its edges, loses its insulating properties fast. Entrapped moisture and other volatiles within the cured structure causes inconsistent dielectric strength, with ultimate puncture and breakdown.



Punch press and bench saw operators know how much time and material is saved when the laminated plastic is *uniform* and *homogeneous* in nature like Dilecto.

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Yes, C-D-F Dilecto is an improved laminated plastic, due to high standards and advances in resin and manufacturing techniques. It is watched by skilled workers in our modern plants, checked against rigid standards . . . C-D-F standards . . . by our quality control people. It is easy to machine, and the C-D-F shops are doing a booming business in specialties.

Table I—Typical Improved Phenolic Laminates

Commercial designation[a]	Resin	Filler	Improved properties	Improvement due to:
MEC-5	Phenolic	Nylon fabric	Insulation resistance; moisture resistance	Filler
XXHV-2[b]	Phenolic	Paper	High dielectric strength parallel to laminations	Resin and manufacturing technique
CRD	Phenolic	Cotton mat	Better machining	Filler
XXXP-26[b]	Phenolic	Paper	Insulation resistance; moisture resistance	Resin and manufacturing technique
C-92	Xylenol[c]	Cotton fabric	Alkali resistance	Resin
CF	Modified phenolic	Cotton fabric	Postforming	Resin

[a] All grades are Continental-Diamond Fibre Company.
[b] Resins have improved penetrating properties and the manufacturing techniques use these properties to provide better impregnation of the filler. Since thorough impregnation eliminates entrapped moisture and air, greater moisture resistance and better dielectric properties are attained. Manufacturing techniques also provide suitable temperature control during the curing stage to assure uniform quality and optimum property values in the finished laminate.
[c] Xylenol is essentially a dimethyl phenol.

—from Electrical Manufacturing Article "Wider Design Opportunities with the NEW Phenolics", Part II.

The next time you think of laminated plastics, the name to remember is C-D-F Dilecto. The improved, high strength, uniform material that makes insulation buying and using more a science, less a puzzle. New grades, new applications, new savings are just part of the Dilecto success story. Look up the facts in Sweet's Design File, or write for catalog. Send us your blueprint for quotation . . . tell us your design dream . . . C-D-F wants to work with you.

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- Flexural strength retention of glass cloth laminates (tested at room temperature)
  - After 168 hrs. at 392°F ..... up to 90%
  - After 720 hrs. water immersion ... 92%
- Shrinkage during curing 5%
- ASTM heat distortion point of castings ..... up to 285°F
- Electrical properties of castings at 10^9 cycles:
  - Dielectric constant 2.85
  - Power factor ..... .00575
  - Loss factor ..... .0164

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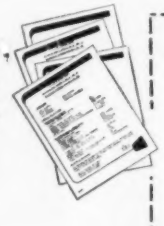

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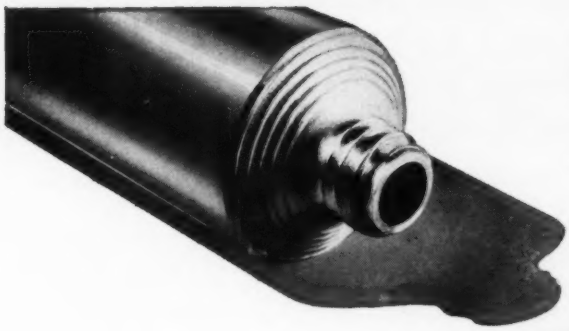
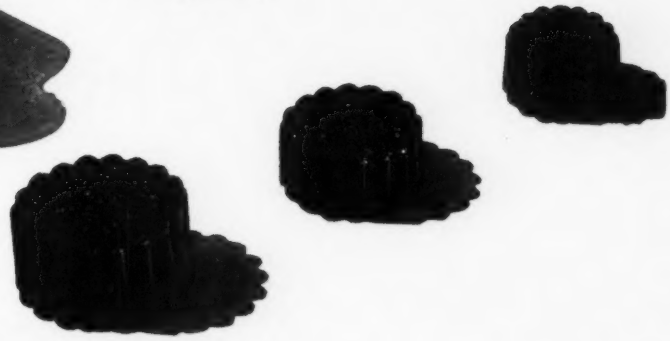
ARE YOU CONFUSED BY TRADE NAMES?
The Plastics Industry is beset by a welter of trade names, many of them confusingly similar. The Directory of Trade Names, beginning on page 899, lists them alphabetically, describes the product, and gives the manufacturer.



- *Economy Size*
- *Giant Size*
- *Large Size*



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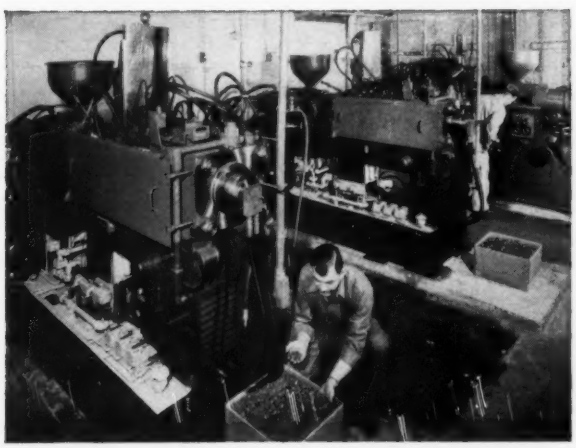

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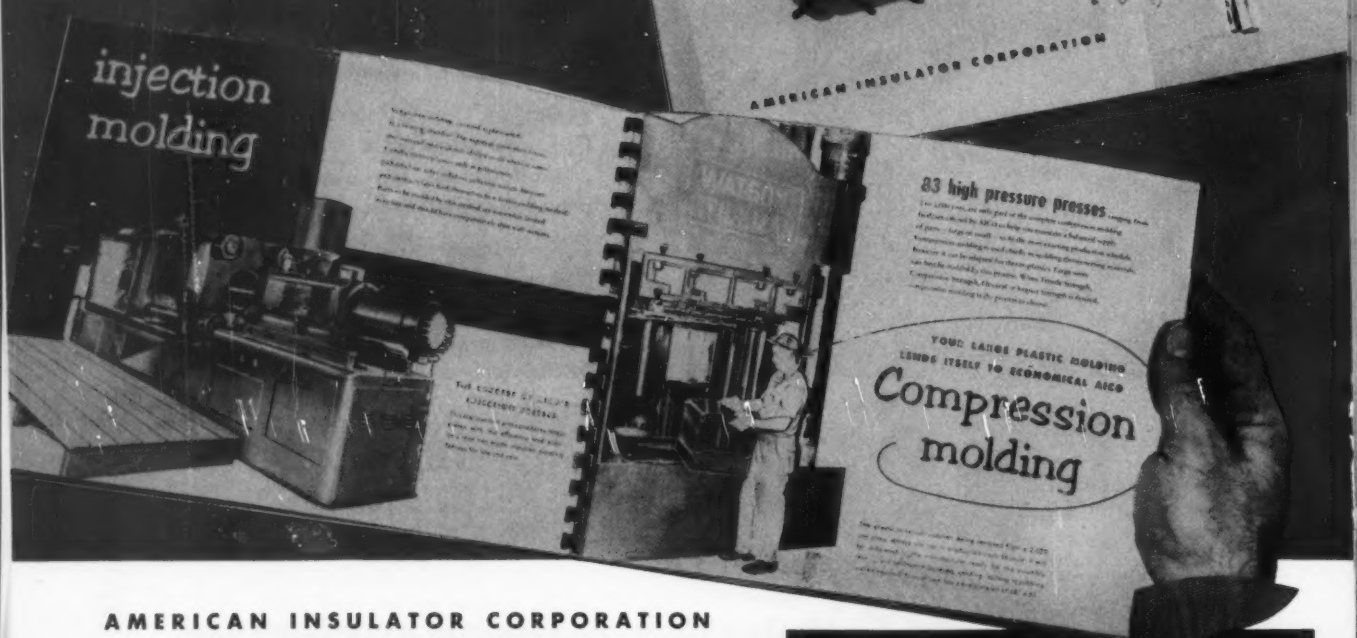
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MODERN PLASTICS

VOLUME 31 NUMBER 11 JULY 1954

COLOR IN PLASTICS

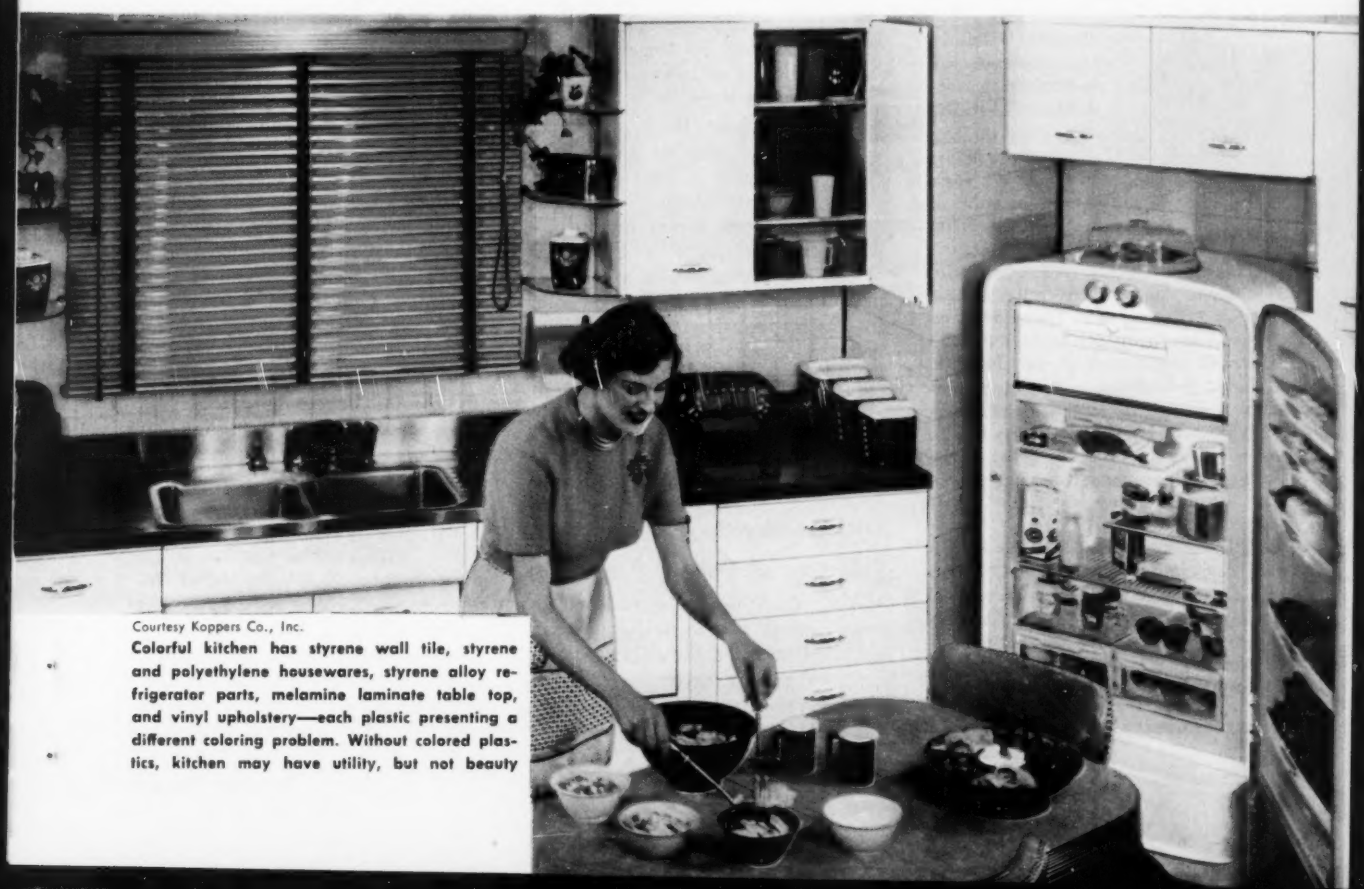
Part I of a Symposium in Print

THE relationship of color chemistry, color engineering, and color in marketing to all kinds of plastics is close, complicated, and often confusing.

Since one or more types of plastics are bound to compete in application with practically every other material known to man, the chemical and physical requirements of colorants in combination with plastics are necessarily very broad. Since plastics may be made rigid or flexible, since they may be opaque, translucent, or transparent, since they may be colored throughout or given surface decoration, the techniques of colorant use are many. Since for a single plastic as many as 70,000 reproducible colors have been established and the number of possibilities is being increased every day, the subject is constantly alive. Since combinations of materials in copolymers and alloys are presently becoming so important, new developments come rapidly. Since all modern merchandising depends on the proper selection and use of color and since plastics are so popular as component materials, good methods of color selection are vital.

On the next page begins the first of a series of fifteen articles on "Color in Plastics." The series will be spread over four issues of MODERN PLASTICS magazine. Each article has been prepared by an expert on the segment of the subject he or she is covering.

The problems involved in color selection, color use, and color promotion in plastics, are paralleled by the magnificent opportunities for improvement in the use of color in plastics. The challenge faces every chemist, every engineer, every designer, every sales and management executive in every company producing plastics materials, plastics components, or products using plastics in any manner or form.



Courtesy Koppers Co., Inc.

Colorful kitchen has styrene wall tile, styrene and polyethylene housewares, styrene alloy refrigerator parts, melamine laminate table top, and vinyl upholstery—each plastic presenting a different coloring problem. Without colored plastics, kitchen may have utility, but not beauty

The Problems of Color in Plastics

by George W. Ingle

THE whole fabric of the plastics industry is threaded with color. Whether in molded air-conditioning cabinets, automobile bodies, or in safety glass implosion plates for its television sets, its meaning has advanced beyond simple attractiveness. Research and development, production and sales—each of these areas finds color an important element in determining costs, sales-volume, and ultimate return on investment.

It is the purpose of this report to introduce a group of new articles by respected authorities in this broad area. While each will discuss problems of particular importance in his own field of specialized activity, the major objectives will be threefold: 1) to bring up-to-date the status of color and coloring problems—both solved and unsolved—in the expanding domain of plastics; 2) to reveal in some detail today's coloring techniques in plastics; and finally 3) to attract new thought and new engineering personnel to this portion of the plastics industry by adding new stature to a field of genuine challenge.

In general, each contributor will review problems involved in the development, manufacture, and sales of a particular major plastic material. These problems will include the selection and testing of colorants, methods of incorporation, and wherever possible, their dollar significance. Some emphasis will be placed on color's unique position as a powerful merchandising tool. The different views of research, sales, and production men will be pictured. While it is too much to hope that all the many facets of color in plastics will be brought into equal focus, this recasting of the over-all view should be immensely valuable to the industry.

Section leader in the research department of Monsanto Chemical Co., Plastics Div., Springfield, Mass., George W. Ingle is in charge of color research on all the company's plastics materials. Mr. Ingle was graduated from Colgate University in 1938 with an A. B. degree in Chemistry, and received his M. S. degree in Pulp and Paper Technology from the Institute of Paper Chemistry in Appleton, Wisconsin, in 1940. He joined Monsanto in that year and has been engaged in color research since 1941, being the author of numerous technical papers and lectures on the subject of color in plastics.

He holds memberships in the American Association of Textile Chemists and Colorists, the American Chemical Society, the American Society for Testing Materials, and the Optical Society of America. He also finds time to be Town Moderator of Hamden, Mass.

Role of Color

If we are to measure the dominating role of color in plastics, we must investigate its impact on the salient features of appearance, performance, and costs. In addition, as will be seen later, there is a small but growing number of applications where the utility of the color itself, as in color standards, for various grading purposes is paramount.

For the purpose of this preview of the succeeding, more specialized presentations, the function of color in plastics may be most simply organized in three parts: 1) the selection of color itself, 2) the selection of colorants, and 3) methods of coloring. These three phases respectively appeal most strongly to sales, research and development, and production groups, but there is naturally considerable overlapping.

Selection of Color

A glance at the price schedule for nearly every plastic quickly reveals a control exerted by color. "Standard" colors are produced in relatively large volume, for immediate sale and occasionally for ultimate sale from warehoused quantities. As a result they cost less per pound than made-to-order special colors for which considerably less demand is evident. The element of production costs responsible for this differential will be discussed elsewhere. Here we are examining primarily the relation between the selection of color and its effect on sales. Naturally we are concerned with the sales of all materials in the complete series beginning with the raw materials, leading through the plastics materials themselves, and finally including finished plastics articles and components.

A basic element in the American economy is the desire for change—change to better satisfy consumer wants. Nowhere is this more evident than in consumer color preference. Witness the demise of Henry Ford's monotonously black Fords—today less than one car in five is black, and the remainder flaunts an ever-broadening gamut of strongly attractive colors.

The importance of color styles for maximal sales of plastics has revealed itself relatively recently with graduation from the "knick-knack" stage and entrance into applications of real utility and beauty. It follows that the more progressive manufacturers, fabricators, and retailers of plastics merchandise are giving closer attention to determining which colors sell the best, at given times and price levels, and in given applications, geographical areas, and for customers with different origins. The cyclic variation of color preferences must be recognized. A relatively few simple colors dominate the lower price and larger dollar volume market. These colors are the sales-selected descendants of a larger number of more complicated, higher style colors in the higher price, but much smaller dollar volume market. These are some of the ground rules in color-styling.

The problems here are many. This is an area where reliable, statistically significant data are too uncommon. Much remains to be done

in market research to obtain really useful information. While promotional efforts in this field are often desirable, they tend to obscure the real large volume market trends, and to divert attention from their more realistic measurement. The precision of predicting best-selling colors may frequently be just as poor as the insistence of a color-stylist on a particular color with narrow tolerances is ludicrous. Perhaps one day this art will advance to the stage where the "standard deviation of consumer preferences" will have some meaning. Then the selection of color may be made with a better understanding of its ultimate effect on costs, availability, and performance.

There is at least one very new development where the color-selection itself is paramount. This is the use of carefully colored plastics for in-the-field grading of agricultural products for quality. The dollar value of the "right" color here is enormous and immediately evident. The vast fruit and vegetable industry of California seems to be leading this revolution.

Selection of Colorants

While much progress has been made in this technology, it is still one which is far from perfection. In spite of this incomplete development, it is this process which ultimately plays a large part in determining appearance, performance, and costs. The latter are not restricted to those of the colorants themselves, but include the far more potent charges for specialized preparation of certain colorants, production-downtime resulting from difficulties in compounding the colorants, and for losses represented by off-color materials devalued to scrap value.

A major problem here is the existence of twin multitudes—a large number of presumably equivalent colorants of unspecified competitive value opposing an equally large number of plastics and their major and minor modifications. In spite of ample cooperation, neither the colorant manufacturer nor the plastics materials manufacturer can be properly informed about the performance of the many combinations possible without major expenditures for time, talent, and testing equipment. Of these three, talent is in the shortest supply.

A host of individuals and groups are making some progress in establishing a sounder situation. More and better instruments are being manufactured to measure the physical aspects of color and other functions of colored materials. Physicists are formulating and applying the laws of optical performance of colorants in plastics and other media. Progressive retailers and commercial laboratories are demanding and developing improved methods of tests. Processing equipment manufacturers are designing new machines for compounding plastics and colorants at accelerated

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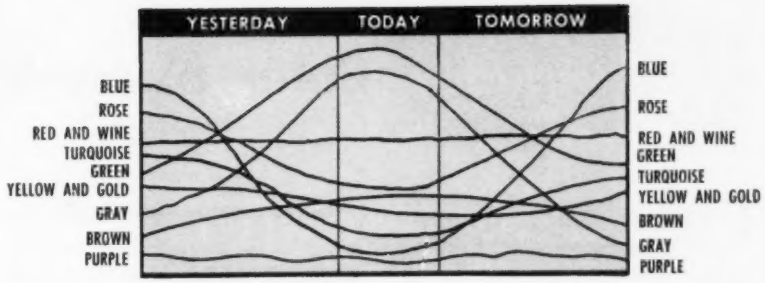
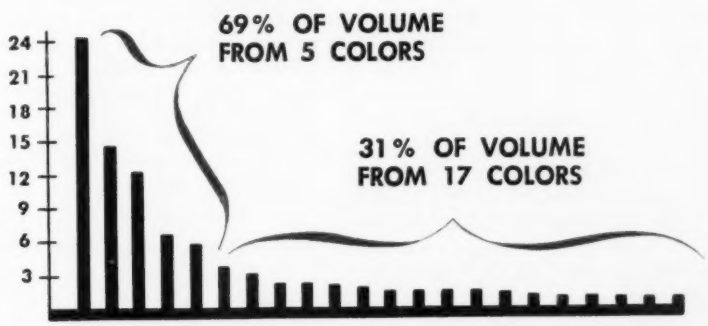
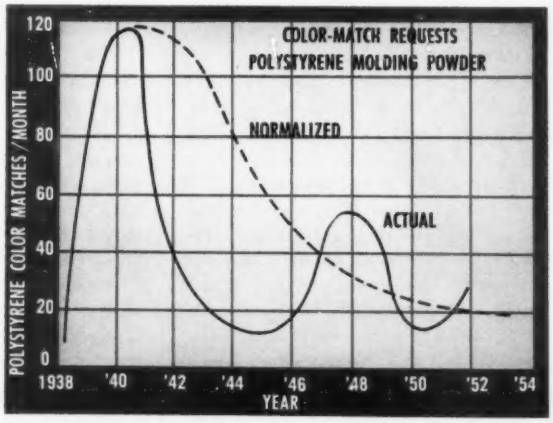


General picture of color preferences shown for average home furnishings, as they existed a decade ago, as they appear today, and as they are likely to be in the future. Color favorites at any one particular period of time tend to decline slowly in popularity, and then to rise again to heights of fashion. Such complete cycles in mass market color preferences generally extend over a period ranging on the average from five to ten years



In practically all lines of merchandise, a few colors will account for the greatest volume. The chart above is based on actual sales records of 22 colors sold to the public in a home furnishings item. Because "poor" colors drain the profit of "good" colors, it is wise policy in mass (though not necessarily in quality) markets to restrict the number of colors offered; but they must be chosen carefully to assure competitive advantage



Requests for special color matches in styrene molding powders, though fluctuating, show a decidedly downward trend over the years and mirror the general color preference picture in plastics. Decline of popularity of the matched color is due both to lessons learned from color preference studies and to the availability of more standard colors

Color Surveys: 5 Methods

by Virginia Eicholtz

ATTEMPTS to analyze and interpret the influence of color on behavior in a scientific manner, for the purpose of influencing the sale of merchandise has become a subject of great interest to American business—particularly to the plastics business.

Techniques for predicting consumer color preferences fall into five general categories, each of which can justifiably lay claim to some degree of validity. Nevertheless, the size and scope of the problems encountered, plus the fact that consumer preference constantly changes and is powerfully influenced by promotion and advertising, makes it impossible to predict color preferences by any of the known current techniques with any high degree of accuracy.

At the present stage of development of these techniques, it should be pointed out that the evaluation and application of knowledge gained by such surveys must be interpreted by persons whose background and particular flair for color establishes them as authorities. Unfortunately, there are all too few such people whose qualifications give them such a status. Nevertheless, the study of color and the application of survey techniques to problems of selling is one which is attracting increasing attention on the part of manufacturers.

Application of these color survey principles is of special interest to the plastics industry where color is significant in most of the plastics products produced from basic plastics raw materials. Probably the best known to plastics manufacturers is that used in the survey sponsored by The Society of the Plastics Industry in 1946, which led to the establishment of color standards in the industry.

I: Survey of Industry

This color survey, conducted by the National Bureau of Standards, polled industrial users on the most popular colors they were currently using. From their answers, 16 standard colors and crystal were selected, and the molders were then asked for their final endorsement.

The effect of this survey, which revealed the most popular colors, was to produce manufacturing economies so that materials companies could make large savings and pass them along to the market. This technique has limitations, however, including the fact that it is difficult to make changes owing to the time-consuming procedure involved. Also, the consumer's selections are not included in the design and results of this type of survey.

Miss Virginia Eicholtz, who received her B. Sc. degree from Missouri State College, joined The Dow Chemical Co.'s Plastics Div. 10 years ago. Handling the development of new products and their introduction to the American consumer market, Miss Eicholtz has become an expert on color in relation to product development, and today is in charge of all color survey work for Dow Chemical's Plastics Division.

II: Survey of Sales Records

The most commonly used method of making color surveys is based on sales records. The simplest way is to check one's own records; second, check other industry records if available, and also those of allied lines.

Statistics on color preference that are available for such merchandise as paints, wallpapers, household accessories (plastics), textiles, and automobiles are also recorded. These facts are analyzed to determine mass color movements, since color trends, by and large, affect many products, inasmuch as the same public is at all times involved. This provides an excellent background for the styling of individual items.

While the sales records method has many advantages, it also has the limitation of basing color information on past records, and therefore can lead to repetition without introducing new colors. The sales record survey requires an expert to interpret it, allowing for seasonal influences, special promotions, and stock shortages, any one of which would greatly influence the results. The retail buying preference survey, by its nature, must be made on the basis of colors actually available. Its effectiveness is limited, therefore, since the consumer does not express a preference for colors which *might* be available but are not.

III: Survey by Consumer Vote

A third survey method is the preselection of a wide range of colors; the consumer casts a vote for her color preference from color samples on display in a department store or home furnishings show.

From the colors on display, each consumer chooses the specific color currently on her kitchen or bathroom walls and her preference if she were redecorating these rooms. A comparison of these results with similar studies on other types of home furnishings determines the colors preferred by these homemakers.

One of the problems encountered with this type survey is the determination of a wide range of colors to be displayed for consumers and the fact that the average consumer does not "carry" colors accurately. The colors used for polling consumers on their preferences in the store are of necessity extremely small areas compared to such items as table cloths or upholstery. Also, there is a considerable time lapse before the data are actually interpreted.

Another important consideration with the preselection method is that many shoppers are influenced by the way merchandise is displayed. For example, a homemaker may have

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Color Sells Plastics

by Lynn Scott

COLOR is the big story in merchandising.

That's what I learned in scores of visits to leading department stores and in talks to thousands of women from coast to coast.

I talk to ladies all over the country, and they also talk to me. The thing that interests them most is color in the home and how to achieve color harmony.

I have had the opportunity to observe women in hundreds of buying situations and time and again color is the deciding factor. When two well-known brands have relatively the same function and the same price and are sold side by side, the one with the more desirable variety of colors will far outsell the other. In many instances buyers put color before price.

My experience is not at all unique. Manufacturers know about this trend to color and are taking advantage of it by making their products available in the most popular colors. Over and over again manufacturers tell me that color is one of the most important ingredients in those products.

And over and over again manufacturers tell me that they selected plastics from which to make their products, not only because of superior and less expensive molding properties but because of the tremendous variety of colors that are available.

Imagine! Plaskon melamine, for instance, is made available in more than 11,500 different hues and tints. Other kinds of plastics also come in thousands of shades and colors.

Plastics are playing an increasingly vital part in helping manufacturers solve color production problems. No matter whether they are manufacturing television sets, dinnerware, clocks, bottle caps, or any of thousands of other products, they need a material that is easily processed into eye-appealing shapes, meets rigid engineering and design

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Lynn Scott, director of the Plaskon Home Arts Council, Barrett Div., Allied Chemical & Dye Corp., Toledo, Ohio, is an expert on home decoration, architectural and furniture styling, whose task is to promote more gracious living in America by the increased and proper use of plastics products and materials. Miss Scott's department functions as a clearing house for news about trends in home-making. Members of her advisory council are Helen Cole, table setting authority; John Gerald, interior design consultant; William Hennessey, architect; Tammis Keefe, fabric designer; Howard Ketcham, color engineer; Mary Deputy Lamson, landscape architect; Paul McCobb, furniture designer; and Edith Ramsay, home equipment authority.

Miss Scott specializes in the application of color to the problems of merchandising and display.

Although it makes a good ad, it is poor merchandising to display colored products against a background that draws attention away from them (bottom photo); it is good practice to place them in a neutral setting that focuses interest on the merchandise (top)

Courtesy Allied Chemical & Dye Corp.

Types of Colorants for Plastics

by William H. Peacock

TO CREATE a great variety of attractive color effects, the colorists and engineers of the plastics industry use about 100 coloring agents selected from the more than 800 available (1, 7).* These colorants may be classified as either pigments or dyes, depending on their solubility in certain commonly used solvents. Pigments are generally insoluble in water and essentially insoluble in most of the processing solvents used in the industry.

Colorants are incorporated into plastics at a convenient point, frequently quite early, in their processing. This is a fact of importance, because at that point and at each successive step of manufacture, the colorants are subjected to physical and chemical attack. Moreover, the colorant may sometimes have inhibiting or catalytic action and may alter physical properties as well as color. The more suitable dyes and pigments meet reasonable processing and end-use requirements, although none is perfect and, under certain conditions, may have some adverse feature. Consequently, colorants can be misapplied if the characteristics of the coloring material, the plastic system, and process are not all considered jointly.

* Numbers in parentheses link to references at end of article, p. 178.

William Henry Peacock, born in Manchester, England, received his B.Sc. degree in chemistry from Cooper Union, and later continued his studies at Brooklyn Polytechnic Institute, Columbia University, as well as Rutgers University.

Mr. Peacock joined Calco in 1923, following several years in colorant production. He is at the present time a research fellow in the Pigments Div., American Cyanamid Co. His activities for several years have been devoted to the application of colorants in the plastics, protective coatings, cosmetics, and textile fields.

The editors of *Modern Plastics* are particularly grateful to Mr. Peacock for the development of the charts on pp. 76 to 79 of this issue, covering the resistance characteristics of various colorants for plastics.

Colorants have been grouped to keep the discussion concise. Individual members of groups will differ and detailed tests must be made on the specific material under consideration. Also, colorants have different properties in different media and no one set of data can cover every characteristic. Although experienced colorists (6) will be able to adapt these data for many problems, reference should be made to other articles in this symposium for details on the coloring of specific types of plastics.

THREE FUNDAMENTAL RULES OF COLORANT PERFORMANCE

There are three special facts or rules which plastics technicians should know about colorants. At some risk of possibly repeating parts

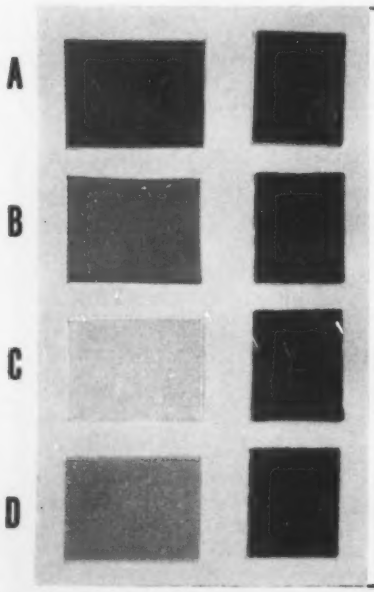

Fig. 1—Behavior of colorants with different plastics and under various thermal conditions. A—Phthalocyanine blue in a fluxed, opacified polyvinyl chloride film produced from a freshly prepared organosol. B—Film similar to A, made after the pigmented organosol has aged six months. C—Dispersion of 0.5% of Rhodamine B Base in a polyethylene sheet. D—Dispersion of 0.5% of Rhodamine B Base in a polyacrylate sheet. E—Polystyrene plaque colored with 0.4% Lake Red C barium toner and 0.1% Rutile titanium dioxide pigment, and injection molded at 500° F. within five minutes. F—Same stock as E, but held in cylinder at 525° F. for 15 min. before molding. G—Same stock as E, but held in cylinder at 550° F. for 15 min. before molding. H—Same stock as E, but held in cylinder at 550° F. for 30 min. before molding.

Loss of tinting strength of the blue in B compared to A may be due to crystal growth of pigment. C and D illustrate the fact that results obtained with a colorant in one type of plastic are no indication of results obtainable in another. E, F, G, and H illustrate the effect of heat on the color of pigmented molding plastics.

of other articles, a number of examples will be given.

1. Colorants have different properties in different media.

Properties in one plastic provide no certain criteria of their characteristics in other plastics. For example, the benzidine yellow toners have better heat resistance in regular than in high-impact polystyrenes. The cadmium reds and yellows, ultramarine blues, and other acid-sensitive colorants are widely useful, yet must be used with care in coloring those plastics that liberate acids at high temperatures, notably in polyvinylidines. In contrast, the iron blues are more suitable for plastics that use acidic rather than alkaline catalysts. The nigrosine hydrochlorides, which give excellent gloss blacks in phenolics and cellulose esters, must be used with caution in amino plastics, whose curing they accelerate, in shellac compositions, which they quickly "deaden," and in polystyrene formulations, where degradation may be induced. Such very stable pigments as the carbon blacks and phthalocyanine blues may have some inhibiting (antioxidant) effects on the curing of polyesters and other peroxide catalyzed polymerizations. Although the titanium dioxides are usually the preferred white pigments for most plastics, they may darken under strongly reducing conditions. The manganese, copper, and zinc derivatives of colorants may induce degradation or devulcanization, particularly in elastomers, a feature also shown by some natural earth pigments. The lead chromates stabilize polyvinyls, whereas the zinc chromate yellows have the opposite effect. Certain vat dyes have very good lightfastness on cellulose fibers, yet fade within one or two hours in polyvinyls, and only a few give good results in both applications. A number of "oil-soluble" dyes have very good lightfastness in polyacrylates and polystyrenes, yet they tend to fade rapidly in cellulose esters. These same dyes are useful colorants for rigid thermoplastics but effloresce or migrate badly from plasticized formulations.

2. The effect of colorants tends to vary with the concentration used, not only in color results but in other properties.

Colorants appear faster to light in strong color effects than in pastels and tints, or as a minor component of a colorant mixture. Pigment scarlet is an exception, for although it darkens more than the duller scarlets, it yields more lightfast pinks than other organic red pigments. Many colorants that have crocking tendencies crock less when used at concentrations below 0.25 percent. Although small percentages of dyes and pigments have limited antioxidant effects, in larger proportions they may delay for days the oxidative drying of oleoresins and retard or inhibit the complete curing of peroxide catalyzed polymers. Increasing colorant concentration can quench fluorescence, promote bronze (2), and produce the widely prevalent dichromatic effects.

3. Different processing methods and various applications of plastics usually stress different colorant properties

Probably no available colorant will meet every coloring requirement. Consequently, those who write specifications should defer to practical considerations. For example, it is impractical, and usually uneconomical, to require colorant resistance at 500° F. for use in a plastic never processed above 350° F. Again, the require-

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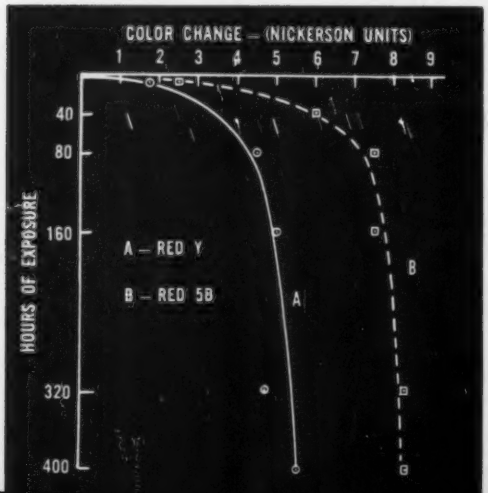


Fig. 2—Comparative fastness to light of two typical red pigments in polyvinyl chloride for exposure of 400 hr.; change in color is described in terms of Nickerson's Fading Index formula

GUIDE TO TABLES

Plastics formulators and engineers using Tables I through X (pp. 76-79), should interpret the ratings for resistance and performance characteristics of the various pigments and dyes listed as follows:

1) Hue—Coloring properties of masstone, undertone, and tint indicate the dichromatic changes related to pigment concentrations or specimen thickness. Transparency, translucency, and opacity indicate compounding flexibility and potentialities.

2) Resistance to heat—Time, temperature, and environment are interrelated influences. Ratings must be interpreted with discretion.

Very good—Useful for high temperature.
Good—Useful at moderately high temperatures.
Moderate—Useful at lower temperatures.
Fair—Should be subjected to heat only for very short periods.
Poor—Useful only in low temperature or wet processes.

3) Resistance to light—Ratings must be accepted with some reservation, since lightfastness varies with many factors. Ratings for organic colorants are for exposures protected from weather.

Excellent—Suitable for outdoor exposure for rather long periods.
Very good—Suitable for outdoor exposure for shorter, but useful periods.
Good—Suitable for outdoor exposures if protected from the weather.
Moderate—Useful for indoor exposure.
Fair—Good only for short-lived uses.
Poor—Useful only where resistance to light is of minor importance.

4) Resistance to bleeding—Ratings are based on tests of unprotected colorant in direct contact with liquids. In actual use, colorants often receive protection from the plastic.

Excellent—Non-bleeding.
Very good—Practically non-bleeding.
Good—Bleeds very slightly, often depending on length of contact, temperature, and vehicle.
Moderate—Bleeds slightly.
Fair—Bleeds to a degree that cannot be ignored in many uses.
Poor—Bleeds badly.

5) Resistance to chemicals—Most of the ratings for acids and alkalies are based on actual tests of the colorants with 5% and 30% hydrochloric acid, 5% soda ash solution, and 30° Bé caustic soda. The ratings versus aldehydes are based on their resistance when used in urea-aldehydes and/or phenolic aldehydes.

Good—Unaffected to appreciable degree.
Moderate—Affected slightly, but not seriously. May be unaffected, if protected by plastic.
Fair—Affected to a degree that limits its use where this type of fastness is required.
Poor—Seriously affected or destroyed.

6) Color index numbers—Refer to the listings in "Color Index" by F. M. Rowe, Society of Dyers and Colourists, Bardford, Yorkshire, England (1924). Prototype numbers are those listed in the "Year Book," American Association of Textile Chemists and Colorists, Howes Publishing Co., New York (issued yearly).

Table I—Performance and Resistance

	Lithol maroon toner	*Alizarine lake B*	*Cadmium maroon*	*B.O.N. red toner (5B)*	*Calcium lithol toner*	*Barium lithol toner*	*Pigment scarlet*	*B.O.N. red toner (Y)*	*Lithol rubine*
Hue: Masstone	Maroon	Maroon	Maroon	Blue red	Blue red	Scarlet	Scarlet	Scarlet	Scarlet
Hue: Undertone	V. blue red	Red violet	Dull violet	Blue red	Blue red	Blue scarlet	Red violet	——	——
Hue: Tint	Red violet	Red violet	Dull violet	Red violet	Red violet	Red violet	Red violet	——	——
Brightness	Mod.	Mod.	Fair	Good	Good	Good	Good	Good	Good
Tinct. strength	Excellent	Good	Weak	V. good	Excellent	Excellent	Mod.	Good	Good
Transparency	Mod.	Good	Poor	Mod.	Mod.	Mod.	Mod.	Good	Mod.
Translucency	Good	Mod.	Fair	Good	Good	Good	Good	Mod.	Mod.
Opacity	Poor	Poor	High	Poor	Poor	Poor	Poor	Poor	Poor
Hiding power	Mod.	Poor	Good	Mod.	Mod.	Mod.	Poor	Poor	Poor
Specific gravity	1.65	1.8	4.72	1.81	1.52	1.6	2.15	1.7	1.7
Resist. to heat	Mod.	Good	V. good	Good	Mod.	Mod.-fair	Good	Mod.	Good
Resist. to light									
Masstone	Mod. (D)	Good-mod.	V. good	Good	Mod. (D)	Mod. (D)	Mod. (D)	V. good	Good
Undertone	Fair	Fair	Good	Mod.	Fair	Fair	Mod. (D)	Mod.	Mod.
Tint	Poor	Poor	Good	Fair	Poor	Poor	Good (D)	Fair	Fair
Resist. to bleeding									
alcohols	Fair	Mod.	Excellent	Excellent	Mod.	Fair	Excellent	V. good	V. good
hydrocarb.-aliph.	Good	Excellent	Excellent	Excellent	Good	Good	Excellent	Excellent	Excellent
hydrocarb.-aroma.	Good	Excellent	Excellent	Excellent	Good	Good	Excellent	Excellent	Excellent
linseed oil	Good	Excellent	Excellent	Excellent	Good	Good	Excellent	Excellent	Excellent
plasticizers	Mod.	V. good	Excellent	Excellent	Good-mod.	Mod.	Excellent	Good	Good
Resist. to chemicals									
acids-dilute	Good	Good	Mod.	Good	Good	Good	Good	Good	Mod.-good
acids-conc. (HCl)	Good	Good	Poor-H_2S	Much bluer	Good	Good	Good	Sl. yellower	Mod. (browner)
aldehydes	Mod.	Good	Good	Good	Good	Good	Mod.	Good	Good
alkalies-dilute	Good	Poor	Good	Good	Good	Good	Fair	Good	Good
alkali 30°B-NaOH	Good	Poor-black	Good	Much bluer	Good	Good	Dissolves	Sl. bluer	——
oxidizing agents	Fair	Fair	Good	Mod.	Fair	Fair	Fair	Mod.	Fair
reducing agents	Poor	Fair	Good	Mod.	Poor	Poor	Fair	Mod.	Poor
Pigment type	Acid-Azo	Anthraquinone lake	Synthetic Inorg.	B.O.N.-B	Acid-Azo	Acid-Azo	Acid-Azo	B.O.N.	Acid-Azo
Color index No.	189	——	——	——	189	189	216	——	136

(D) = Darkens.

Table II—Performance and Resistance Properties of Selected Orange Pigments

	Molybdate orange	*Bronze orange*	*Dinitraniline orange*	*Benzidine orange*	*Chrome orange light*	*Cadmium orange*
Hue: Masstone	Red orange	Med. orange	Red orange	Orange	Orange	Red yellow
Hue: Undertone	Red orange	Red orange	Red orange	Red orange	Orange	Red yellow
Hue: Tint	Yellow pink	Yellow pink	Yellow pink	Red orange	Red orange	Red yellow
Brightness	Good	V. good	Good	Good	Mod.	Good
Tinct. strength	Mod.	Good	Good	Good	Weak	Weak
Transparency	Poor	Mod.	Fair	Fair	Poor	Poor
Translucency	Fair	Mod.	Good	Good	Fair	Poor
Opacity	High	Poor	Poor	Poor	High	Good
Hiding power	Good	Fair	Fair	Fair	Good	Fair
Specific gravity	5.61	1.5	1.59	1.35	6.76	4.18
Resist. to heat	Mod.	Mod.	Mod.	Mod.	Mod.	Good
Resist. to light						
Masstone	Good (D)	Mod.	Mod.	Mod.	Good	Good
Undertone	Mod.	Fair	Fair	Fair	Mod.	Mod.
Tint	Mod.	Poor	Poor	Poor	Mod.	Mod.
Resist. to bleeding						
alcohols	Excellent	Fair	Poor	Mod.	Excellent	Excellent
hydrocarb.-aliph.	Excellent	Mod.	Fair	Mod.	Excellent	Excellent
hydrocarb.-aroma.	Excellent	Mod.	Poor	Fair	Excellent	Excellent
linseed oil	Excellent	Good	Good	Good	Excellent	Excellent
plasticizers	Excellent	Poor	Poor	Mod.	Excellent	Excellent
Resist. to chemicals						
acids-dilute	Mod.	Mod.	Good	Good	Fair	Mod.
acids-conc. (HCl)	Destroyed	Fair	Good	Brown	——	Poor-H_2S
aldehydes	Mod.	Black	Good	Mod.	Mod.	Good
alkalies-dilute	Fair	Good	Good	Good	Poor	Good
alkali 30°B-NaOH	Yellow	Sl. redder	Good	V. sl. redder	——	Good
oxidizing agents	Mod.	Mod.	Fair	Fair	Mod.	Good
reducing agents	Fair	Fair	Poor	Poor	Fair	Good
Pigment type	Inorganic	Acid-Azo	Azo	Azo	Inorganic	Inorganic
Color index No.	——	165	——	——	——	——

(D) = Darkens.

Properties of Selected Red Pigments

	Brilliant red lake R	*Lake red C barium toner*	*Red lead*	*Sodium lithol toner*	*Toluidine toner light*	*Cadmium red light*	*Rhodamine toner B*	*Rhodamine toner Y*	*Para red toner light*	*Chlorinated para red toner*
	Yellow red	Scarlet	Dull red	Yellow red	Scarlet	Scarlet	V. blue red	Bluish red	Scarlet	Yellow red
	Scarlet	Scarlet	Dull red	Scarlet	Scarlet	Dull blue red	Red violet	Bluish red	Scarlet	Scarlet
	Scarlet	Blue pink	——	Blue pink	Blue pink	Dull red violet	Red violet	Bluish red	Blue pink	Blue pink
	V. good	V. good	Mod.	V. good	V. good	Masstone-good	Good	V. good	Good	V. good
	Good	Good	Weak	Good	Good	Weak	V. good	V. good	Good	Good
	Mod.	Mod.	Poor	Mod.	Mod.	Poor	Good	Mod.	Mod.	Mod.
	Good	Good	Poor	Good	Mod.	Poor	Mod.	Mod.	Mod.	Mod.
	Poor	Poor	Good	Fair	Poor	High	Poor	Poor	Poor	Poor
	Mod.	Poor	Good	Mod.	Mod.	Good	Mod.	Poor	Mod.	Mod.
	1.59	1.70	8.9	1.63	1.45	4.21	2.75	2.40	1.45	1.65
	Mod.	Mod.	Mod.-good	Mod.	Good	V. good	V. good	Good	V. good	Mod.
	Mod.	Mod. (D)	Good	Mod. (D)	V. good	Excellent	Mod. (D)	Mod. (D)	Good	Good
	Fair	Fair	——	Poor	Mod.	Good	Fair	Fair	Mod.	Mod.
	Poor	Poor	——	Poor	Fair	Good	Poor	Poor	Poor	Poor
	Poor	Mod.	Excellent	Poor	Fair	Excellent	Poor	Poor	Poor	Mod.
	Mod.	Mod.	Excellent	Mod.	Mod.	Excellent	V. good	V. good	Mod.	Fair
	Mod.	Mod.	Excellent	Mod.	Mod.	Excellent	Good	Mod.	Mod.	Fair
	Good	Good	Excellent	Mod.	Mod.	Excellent	Good	Good	Mod.	Mod.
	Poor	Fair	Excellent	Poor	Poor	Excellent	Poor	Poor	Poor	Poor
	Mod.	Good	——	Fair	Good	Mod.	Fair	Mod.	Good	Good
	Violet	Bluer	——	Brownish	Good	Poor—H_2S	Or. brown	Mod.	Good	Good
	Good	Mod.	——	Mod.	Good	Good	V. good	Yellow brown	Good	Mod.
	Good	Good	——	Good	Good	Good	Fair	Mod.	Good	Good
	Good	Good	——	Good	Good	Good	Sl. darker	Sl. bluer	Bluer	Good
	Fair	Fair	——	Fair	Fair	Good	Fair	Fair	Fair	Fair
	Poor	Poor	Good	Poor	Poor	Good	Good	Good	Poor	Poor
	Acid-Azo	Azo	——	Azo	Azo	Inorganic	P.T.A.	P.T.A.	Azo	Azo
	35	165	——	189	69	——	——	——	44	——

Table III—Properties of Selected Yellow Pigments

Cadmium lemon yellow	*Benzidine yellow*	*Hansa yellow G*	*Chrome yellow medium*
Yellow	Yellow	Yellow	Sl. red yellow
Yellow	Yellow	Yellow	Yellow
Sl. green yellow	Yellow	Yellow	Yellow
Mod.	Good	Good	Good
Weak	V. good	Mod.	Mod.
Poor	Fair	Fair	Poor
Fair	Good	Good	Fair
High	Poor	Poor	High
Mod.	Poor	Poor	Good
4.26	1.44	1.45	5.88
Good	Mod.	Mod.-good	Good
V. good	Good	Good	Mod. (D)
Mod.	Mod.	Mod.	Mod. (D)
Mod.	Fair	Mod.	Mod. (D)
Excellent	Mod.	Poor	Excellent
Excellent	Good	Mod.	Excellent
Excellent	Fair	Fair	Excellent
Excellent	Good	Good	Excellent
Excellent	Mod.	Poor	Excellent
Poor	Good	Good	Mod.
Poor-H_2S	Good	Good	Green soln.
Good	Mod.	Good	Good
Good	Good	Good	Mod.
Good	Good	Good	Yellow brown
Mod.	Fair	Fair	Good
Mod.	Fair	Fair	Poor
Inorganic	Azo	Azo	Inorganic
——	——	Pr-103	1270

Table IV—Properties of Selected Green Pigments

Malachite green toner	*Chrome green light*	*Hydrated chromium oxide*	*Phthalocyanine green*
Dk. green	Med. green	Blue green	Dk. green
Med. green	Yellow green	Blue green	Sl. blue green
Med. green	Yellow green	Gray green	Sl. blue green
Good	Mod.	Soft tone	Good
Good	Mod.	Weak	Good
V. good	Poor	Poor	Mod.-good
Fair	Fair	Fair	Mod.
Poor	High	High	Poor
Mod.	Good	Good	Mod.
2.65	5.08	3.7	1.91
Fair	Mod.	V. good	Good-mod.
Mod. (D)	Good (D)	V. good	V. good
Mod. (D)	Mod. (D)	Good	Good
Poor	Mod. (D)	Good	Good
Poor	Excellent	Excellent	Excellent
Good	Excellent	Excellent	Excellent
Good	Excellent	Excellent	Excellent
Good	Excellent	Excellent	Excellent
Poor	Excellent	Excellent	Excellent
Good	Mod.	Good	Good
Poor-brown	Black	Good	Good
Mod.	Mod.	Good	Good
Good	Poor	Good	Good
Good	Brown	Good	Good
Poor	Good	Good	Fair
Fair	Fair	Mod.	Mod.
P.T.A.	Inorganic	Inorganic	Chlor. copper phthalocyanine
——	1298	1292	Pr-483

Table V—Performance and Resistance Properties of Selected Blue and Violet Pigments

	Peacock blue toner	*Permanent peacock blue*	*Victoria blue toner*	*Iron blue*	*Phthalocyanine blue*	*Ultramarine blue*	*Alkali blue toner*	*P.T.A. violet toner*
Hue (Masstone)	Green blue	Green blue	Dk. violet	Black	Black	Red blue	Dk. navy	Black
Hue (Undertone)	Green blue	Green blue	Red blue	Med. blue	Med. blue	Red blue	Red violet	Sl. red violet
Hue (Tint)	Green blue	Green blue	Med. blue	Sl. green blue	Med. blue	Red blue	Sky blue	Sl. red violet
Brightness	V. good	Good	Good	Mod.	Good	Good	Good	Good
Tinct. strength	Mod.	Mod.	Good	Good	V. good	Weak	Good	Good
Transparency	V. good	Good	V. good	Good	Mod.	Good	Mod.	V. good
Translucency	Fair	Fair	Fair	Fair	Mod.	Fair	Mod.	Fair
Opacity	Poor	Poor	Poor	Poor	Poor	Poor	Fair	Poor
Hiding power	Poor	Poor	Mod.	Mod.	Mod.	Poor	Fair	Mod.
Specific gravity	2.00	2.45	1.85	1.80	1.65	2.32	1.28	2.30
Resist. to heat	Good	Mod.	Mod.-good	Good	Good	Good	Mod.	Mod.
Resist. to light								
Masstone	Poor	Fair	Mod. (D)	Good	Good	V. good	Mod.	Mod. (D)
Undertone	Poor	Poor	Fair	Good	Good	Good	Fair	Fair
Tint	Poor	Poor	Poor	Mod.	Good	Good	Poor	Poor
Resist. to bleeding								
alcohols	Poor	Poor	Poor	Excellent	Excellent	Excellent	Poor	Poor
hydrocarb.-aliph.	Good	Good	Good	Excellent	Excellent	Excellent	Good	Good
hydrocarb.-aroma.	——	——	Fair	Excellent	Excellent	Excellent	Mod.	Good
linseed oil	——	——	Mod.	Excellent	Excellent	Excellent	Good	Good
plasticizers	Poor	Poor	Poor	Excellent	Excellent	Excellent	Poor	Poor
Resist. to chemicals								
acids-dilute	Mod.	Mod.	Mod.	Good	Good	Poor	Good	Good
acids-conc. (HCl)	Yellow soln.	Dull yellow	Dull red	Black	Black	Poor-H_2S	Mod.	Yellow brown
aldehydes	Good	Mod.	Mod.	Mod.	Mod.	Mod.-good	Mod	Mod.
alkalies-dilute	Mod.	Mod.	Mod.	Poor	Good	Good	Fair	Good
alkali 30°B-NaOH	Black	Sl. darker	Mod.	Brown	Good	Good	Poor	Good
oxidizing agents	Fair	Fair	Poor	Good	Good	Good	Mod.	Poor
reducing agents	Mod.	Mod.	Mod.	Poor	Mod.	Mod.	Mod.	Fair
Pigment type	Acid dye lake	P.T.A.	P.T.A.	Inorganic	Copper phthalocyanine	Inorganic	Organic	P.T.A.
Color index No.	——	——	——	1288	Pr-481	——	704	——

(D) = Darkness.

Table VI—Performance and Resistance Properties of Selected Brown Inorganic Pigments

	Ochre	*Raw sienna*	*Burnt sienna*	*Raw umber*	*Burnt umber*	*Red iron oxide*	*Yellow iron oxide*
Hue (Masstone)	V. yellow brown	Yellow brown	Sl. yellow brown	Red brown	Dk. red brown	Lgt. red brown	Khaki yellow
Hue (Undertone)	V. yellow brown	Yellow brown	Sl. yellow brown	Red brown	Dk. red brown	Lgt. red brown	Dull yellow
Hue (Tint)	V. yellow brown	Yellow brown	Sl. yellow brown	Red brown	Gray brown	Lgt. red brown	Dull yellow
Brightness	Poor	Poor	Poor	Poor	Poor	Poor	Fair
Tinct. strength	Weak	Weak	Weak	Weak	Weak	V. weak	Weak
Transparency	Poor	Poor	Poor	Poor	Poor	Poor	Mod
Translucency	Fair	Mod.	Mod.-good	Mod.	Mod.	Fair	Mod.
Opacity	Mod.	Mod.	Mod.	Mod.	Mod.	Mod.	Mod.
Hiding power	Fair	Fair	Fair	Fair	Fair	Mod.	Fair
Specific gravity	2.88	2.97	3.48	3.1	3.6	4.4	4.0
Resist. to heat	Mod.-good	Mod.	Good	Good	Good	Mod.	Mod.-redder
Resist. to light	Good	Good	V. good	Good	V. good	Good	Good
Resist. to bleeding	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Resist. to chemicals	Good	Good	Good	Good	Good	Good-mod.	Good-mod.
Pigment type	Inorganic CI-1267	Inorganic	Inorganic	Inorganic	Inorganic	Inorganic	Inorganic

Tables IX and X—Solubility and Resistance Properties of

	A.A.T.C.C. name	*Type of dye*	*Closest color index number*	*Solubility in* Alcohol	*Carbon tetrachloride*	*Ethyl acetate*	*Glycerine*	*Glycol*	*Glycol ether*	*Naphtha (V.M.P.)*	*Petroleum naphtha*	*Toluene*	*Ethylene dichloride*
Oil-Soluble Dyes	[1]Sudan II (Scarlet)	——	73	0.1	10	S	—	I	5.0	—	0.7	9.0	9.0
	Sudan I (Orange)	——	24	1.2	4.0	S	—	I	3.3	—	1.1	7.8	S
	Oil yellow 2G	——	—	0.3	SS	S	—	I	2.0	—	0.2	2.7	5
	Chinoline yellow SIS	——	800	0.19	SS	SS	—	I	S	—	0.06	0.6	S
	Alizarine cyanine green base	——	1078	0.2	1.0	SS	—	I	0.5	—	0.1	2.0	4.0
	Irisol R base	——	1073	0.3	S	S	—	I	1.0	—	0.8	4.0	7.0
	Anthraquinone violet base	——	1080	0.3	SS	S	—	I	0.7	—	0.4	8.0	25.0
	Induline base	——	860	4.0	2.0	S	—	I	12.0	—	I	6.0	5.0
	Nigrosine base	——	864	1.9	SS	S	—	I	8.0	—	—	2.0	10.0
Water-Soluble Dyes	[2]Rhodamine B	Basic	749	15	—	—	S	S	S	I	—	I	—
	Orange II	Acid	151	0.5	—	—	8.0	S	16	I	—	I	—
	Metanil Yellow	Acid	638	1.0	—	—	2.5	S	60	I	—	I	—
	Patent blue A	Acid	714	S	—	—	8.0	S	S	I	—	I	—
	Nigrosine water-sol.	Azine	865	SS	—	—	S	S	SS	I	—	I	—
	Nigrosine spirit-sol.	Azine	864	15	—	—	SS	SS	10	I	—	1.5	—

[1]Where figures are listed they represent grams per 100 ml. In all cases an excess of dye was present so that these approach saturation. Seldom does any dye completely dissolve at high concentrations.

Abbreviations: S = At least 1 gram/100 ml.; SS = Less than 1 gram/100 ml.; I = Insoluble.

[2]Abbreviations: S = At least 19 m/ml.; SS = Less than 19 m/100 ml.; I = Insoluble; V = Very; Mod. = Moderate.

[3]All oil-soluble dyes have very good light fastness in polystyrenes.

Table VII—Performance and Resistance Properties of Selected Black Pigments

	Lamp black	*Carbon black*	*Bone black*	*Mineral black*	*Black iron oxide*	*Aluminum powder*
Carbon content (%)	88-99.5	85-95	8-16	10-24 (76.5)	——	——
Tinct. strength	V. good	V. good	Mod.	Mod.	Weak	Good
Specific gravity	1.75	1.81	2.53	2.68	4.95	2.55
Resist. to heat	Excellent	Excellent	V. good	Good	Good	Good
Resist. to light	Excellent	Excellent	V. good	Good	Good	Excellent
Resist. to bleeding	V. good	V. good	V. good	Good	Good	Excellent
Resist. to chemicals	Excellent	Excellent	V. good	Good	Mod.	Fair

Table VIII—Performance and Resistance Properties of Selected White Pigments

	Anatase titanium dioxide	*Rutile titanium dioxide*	*Zinc sulfide*	*Lithopone*	*Zinc oxide*	*White lead*	*Antimony oxide*
Tinct. strength	Excellent	Excellent	Mod.	Mod.	Mod.	Mod.	Fair-mod.
Brightness	Excellent	Excellent	Good	Good	Good	Good	Good
Transparency	Very low	Very low	Very low	Poor	Poor	Poor	Poor
Translucency	Fair	Fair	Mod.	Mod.	Mod.	Fair	Mod.
Opacity	Very high	Very high	High	High	High	High	High
Hiding power	Excellent	Excellent	Good	Good	Good	Good	Good
Specific gravity	3.8	4.2	4.0	4.3	5.59	6.7	——
Resist. to heat	V. good	V. good	Good	Good	Good	Good	Good
Resist. to light	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Resist. to bleeding	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Resist. to chemicals							
acids-dil.	Good	Good	Mod.	Mod.	Mod.	Mod.	Mod.
acids-conc. (HCl)	Mod.	Mod.	Poor (H_2S evolved)	Poor (H_2S)	Fair	Fair	Fair
aldehydes	Good	Good	Good	Good	Good	Good	Good
alkalies-dil.	Good	Good	Good	Good	Mod.	Mod.	Mod.
alkali 30°B-NaOH	Good	Good	Good	Good	Mod.	Mod.	Fair
oxidizing agents	Good	Good	Mod.	Mod.	Good	Good	Good
reducing agents	Mod.-fair	Mod.-fair	Mod.	Mod.	Mod.	Mod.	Fair
Pigment type	Inorganic	Inorganic	Inorganic	Inorganic	Inorganic	Inorganic	Inorganic

Selected "Oil-Soluble"[1] Dyes and "Water-Soluble"[2] Dyes

Solubility in								*Resistance to*					
o-Dichlor benzol	*Nitro-propane*	*Acetone*	*Mineral oil*	*Castor oil*	*Plasti-cizers*	*Water*	*Polyethylene glycol No. 200*	*Heat*	*Light*[3]	*Acids*	*Alkalies*	*Aldehydes*	*Formalde-hyde*
S	S	6.0	0.8	SS	S	I	2.0	Good	Mod.	Good	Mod.	Good	——
S	S	4.0	1.0	SS	S	I	1.4	Good	Mod.	Good	Mod.	Good	——
S	S	1.2	0.2	SS	S	I	0.24	Good	Good	Good	Good	Good	——
S	S	S	SS	SS	S	I	0.24	Good	Mod.	Good	Good	Good	——
S	SS	0.3	0.1	SS	S	I	0.08	Mod.	Mod.	Good	Good	Mod.	——
S	S	1.0	0.2	S	S	I	0.14	Mod.	Mod.	Good	Good	Mod.	——
S	S	0.5	0.3	S	S	I	0.1	Mod.	Mod.	Good	Good	Mod.	——
S	SS	14.0	I	S	S	I	55.0	Good	Mod.	Good	Good	Good	——
S	SS	7.8	I	SS	SS	I	33.0	Good	Good	Good	Good	Good	——
—	—	S	—	—	—	20	——	Good	Mod.	Good	Good	——	V. good
—	—	SS	—	—	—	10	——	Good	V. good	Good	Mod.	——	Good
—	—	S	—	—	—	5	——	Good	Mod.	Good	Violet	——	V. good
—	—	S	—	—	—	15	——	Good	Mod.	Mod.	Mod.	——	Good
—	—	SS	—	—	—	25	——	Good	Mod.	Good	Mod.	——	Good
—	—	S	—	—	—	1	——	Good	Good	Good	Mod.	——	Good

[1]Where figures are listed they represent grams per 100 ml. In all cases an excess of dye was present so that these approach saturation. Seldom does any dye completely dissolve at high concentrations.

Abbreviations: S = At least 1 gram/100 ml.; SS = Less than 1 gram/100 ml.; I = Insoluble.

[2]Abbreviations: S = At least 19 m/ml.; SS = Less than 19 m/100 ml.; I = Insoluble; V = Very; Mod. = Moderate.

[3]All oil-soluble dyes have very good light fastness in polystyrenes.

THROUGH the use of a foamed vinyl plastisol material, conveniently applied in liquid form and expanded by heat during the curing process, The American Motors Corp. in its Kelvinator, Grand Rapids, Mich., plant has greatly improved the gasketing of the metal service door or access panel used on the back of its refrigerators. The purpose of these panels, which are fastened to the back of the appliance by means of drive screws, is to close the opening through which the evaporator is installed and to permit access to the mechanism for later servicing. A gasket is used around the outer edge of the service door in order to seal the opening tightly.

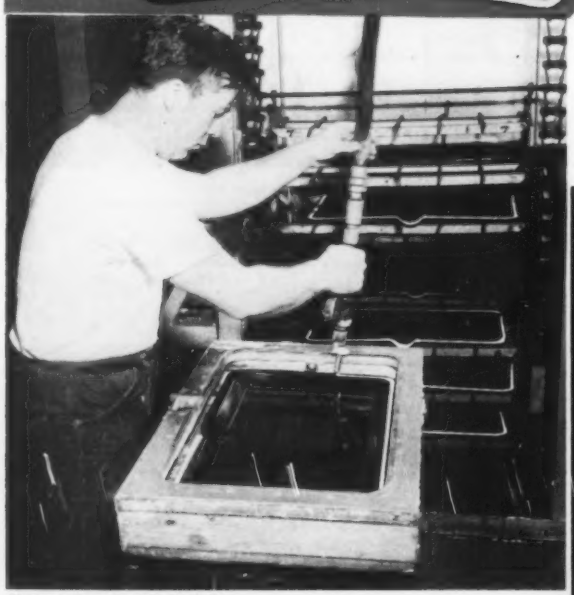
The new type plastic gasket, white in color, not only does a more effective sealing job than that used earlier, but also has made possible reduction of costs, more uniform application, and more efficient use of labor. The earlier type gasket was made of a black mastic sealing tape which had to be cut to proper length and applied manually to the access panels. This gasketing method required three people, of whom two cut and applied the gaskets while the third was kept busy trucking plates to the operator's table and finished plates to the final assembly line on the floor above.

Chief disadvantages of the earlier type gasket were the relatively high labor cost, lack of uniformity due to multiple operators, high rejection rate resulting from leaks, and the large amount of factory floor area required. Cost studies indicated that adoption of the foamed vinyl gasket material effected a saving of about 38%, as compared to the black mastic tape. Production has now been completely changed over.

Application

In switching to the new material and method, Kelvinator was able to relocate the gasket operation adjacent to a conveyor line which brings the sheet metal cover plates directly to the operator. After applying the vinyl plastisol to the shallow groove around the edge of the 16- by 37-in. metal panels, the operator places each unit on a vertical oven conveyor where it is cured and foamed for a period of three or four min. at a temperature of 345° F. while being conveyed to the next floor. Here the panels emerge beside the final assembly line, ready to be mounted on the refrigerators. This new arrangement reduces the num-

VINYL FOAM



Photos courtesy Interchemical Corp.

Gasket is applied to refrigerator access door as liquid vinyl, heat-expanded to its final form in vertical oven (background)

While foamed gaskets of access door expand *in situ* under heat, they are transported to the assembly line, where they are removed

ber of employees required from three to one and increases production by 50 percent.

Actual application of the plastisol material is accomplished by means of a high-pressure lubricating pump which forces the material, in wet paste form, out through a nozzle with a 3/32-in. opening. The service doors are mounted horizontally in a jig which holds them in position during this phase of the operation. The use of an accumulator in the system provides an even flow of plastisol through the nozzle.

After laying down a small, wet bead of the material, the operator transfers each panel to the vertical oven for the curing cycle. On the Kelvinator application, an input pressure of 30 to 40 p.s.i. is used on an 8 to 1 ratio pump yielding an applied pressure of 250 to 320 p.s.i. to force the vinyl material through the nozzle of the gun. The amount of material applied to the cover plate may be controlled by the size of the nozzle orifice, the amount of air pressure used, and the speed with which the operator moves the nozzle. Currently, Kelvinator is using one operator, who flows the plastisol into the flange of the plates at a thickness of 1/16 inch. Within a relatively short time, the operator became so proficient that rejections due to uneven application were practically non-existent.

The vertical conveyorized oven used in this installation provides a brief preheat zone and a subsequent baking time of three min., after which the material passes through a cooling tunnel equipped with a ventilator fan. By the time the panels emerge on the next floor, they have been cooled to room temperature. Compressed during application to the refrigerator in the manufacturing operation, the resilient gasket recovers its original dimension sufficiently when the cover plate is removed in the field for servicing, again providing a perfect seal when replaced.

Expansion

The foamed vinyl plastisol used in this gasketing application is of a relatively new type which may be atmospherically expanded under heat without further modification, requiring neither molds nor pressure. The wet paste, which may be foamed on most materials that will withstand the elevated temperatures, is heated in circulating air at from 325 to 350° F. for from three to 30 min., depending upon the temperature used and the thickness desired. During the brief curing period, the wet material increases in volume from 300 to 400% and changes to a foamed texture. Within the temperature range cited above, expanded vinyl sheeting from 1/8 to 1/2 in. thick has been produced on a continuous basis.

The basic properties of the expanded vinyl plastisol are the same as those of conventional plastisols—they do not support combustion and offer excellent resistance to oxidation, oils, greases, and most acids and solvents. Odorless and migration-resistant, the material can be varied in viscosity to permit application from pressure guns or by spray technique as required. Compression set of the formulation used on the Kelvinator gaskets (percentage loss of height after compression to one-half original thickness) is 24.0% after 1/2 hr. rest and 1.0% after 20 hr. of rest. When used as a heat insulator, the material has a K value of 0.36—about equivalent to that of felt or balsa wood.

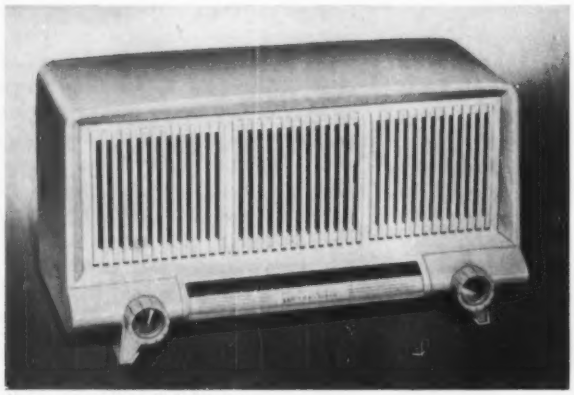
Because of its high expansion ratio, this type of vinyl plastisol yields an expanded density as low as 12 lb./cu. ft., thereby making it possible to use a much smaller amount of material to seal a given opening. The compound can be specially tailored to meet a wide range of end-use requirements. In addition to gasketing applications, weatherstripping, etc., the material can also be sprayed on the inside of housings for air conditioners, business machines, etc., to provide sound-deadening or heat-insulating properties. Used in connection with vinyl film or vinyl-coated fabrics, it may be employed to produce resilient arm rests and cushions. The material may also be applied to textiles by means of a doctor blade, to provide a resilient backing up to 1/2 in. in thickness. When firm adhesion to metals is required, special primers can be used on the metal surface prior to application.

MAKES BETTER GASKETS

Liquid vinyl plastisol that expands under heat is economic replacement for mastic tape as gasketing for refrigerator door

At assembly point, an operator fastens the plastic-gasketed access door to rear of refrigerator by means of drive screws

CREDITS: Vynafoam expanded vinyl No. 7813 supplied by Finishes Division, Interchemical Corp., New York, N. Y. Pumping unit and nozzle for applying material supplied by Lincoln Engineering Co., St. Louis, Mo.



Photos courtesy Henry Keck Associates

Center panel, molded with same design as end panels, is added to styrene case when case is to be used to house conventional radio

As a housing for a clock radio, the same molded case can be used by simply replacing the center panel with the clock face

One Mold—Two Radios

Production costs are cut by designing one basic molded styrene case for housing two different types of radios

BY USING one molded styrene case that can double, with minor modifications, as a housing for either a clock radio or a conventional radio, the Hoffman Radio Corp. has eliminated the extra production costs involved in making separate molds for each model.

As designed by Henry Keck Associates, Pasadena, Calif., this basic housing is an attractive one-piece unit measuring 12½ in. long, 6$^{3}/_{16}$ in. high, and 6½ in. deep—large enough to accommodate either the 4- by 6-in. oval speaker which is used in the conventional radio or the two 4-in. speakers for the clock radio.

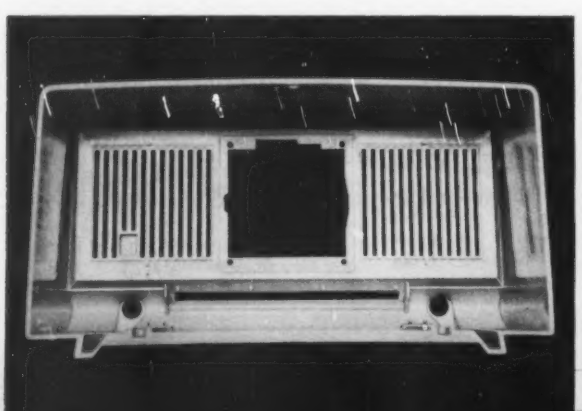
The 23.9-oz. housing is molded in a 48-oz. preplasticizing injection molding machine and is available in grey, tan, maroon, or black. The front of the housing is divided into three equally sized sections. Molded-in open grille panels fill the two end sections. The center section is left open.

When the case is to be used for housing a conventional radio, a third panel, styled with the same grille work pattern as the two end panels and molded simultaneously with the housing, is fitted into the open center section. Four studs molded into each corner of this panel mate with four holes molded into the corners of the rim that circles the center section. Heat is applied to the end of these studs at the point where they pass through the holes so that they deform into a rivet-like shape that holds the panel permanently in place on the radio cabinet.

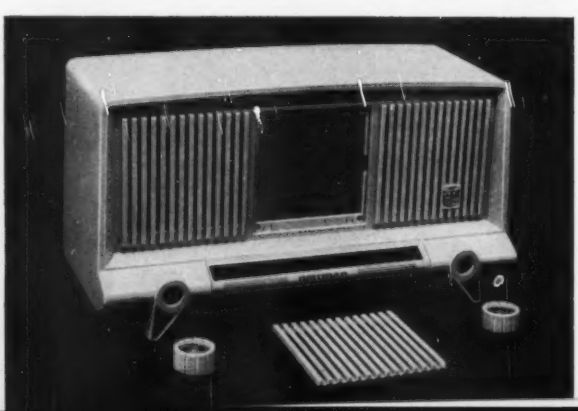
When the housing is to be used for the clock radio, a clock mechanism is snugly fitted into the open center section and securely locked into position from the rear.

CREDITS: Housing is molded by Peerless Plastics Inc., Culver City, Calif., using Styron 700 styrene material supplied by The Dow Chemical Co.

Deep basic housing, including legs, end panels, light shield, and openings for dial face and knobs, is molded in one piece



Molded-in openings in each corner of center section are designed to accommodate four matching studs molded into corners of panel

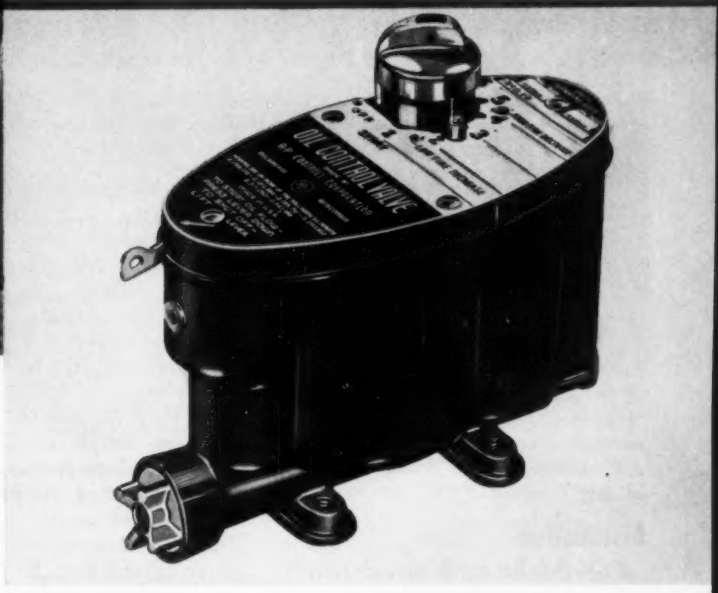


VINYL FINISH FINAL

A single coat of colored plastisol applied on continuous production line meets every physical and chemical requirement in protecting oil control valves

Photos courtesy A-P Controls Corp.

Metal valve body coated with vinyl plastisol (foreground) does not corrode even after 48-hr. salt spray test. Untreated metal body (background) is severely attacked by corrosive solutions used in the test



In addition to corrosion-resistance, vinyl coating provides metal bodies with glossy color finish

SERVICE life of cast metal bodies of control valves for oil heating equipment is being greatly extended by the application of a specially formulated vinyl protective coating which also simultaneously colors the parts so that there is no longer any need to provide them with additional surface finishes.

Function of these oil control valves, which are produced by A-P Controls Corp., Milwaukee, Wis., is to maintain an even flow of oil from supply tank to the vaporizing burner of any space heater, furnace, or similar piece of equipment. In operation, oil enters the valve at the inlet, is strained through a screen, and then proceeds through the inlet needle valve into the float chamber where the proper oil level is maintained. From here, the oil flows at a preselected rate through the metering stem assembly to the outlet leading to the burner. Should any unusual condition cause the oil to rise above normal operating level, a patented safety trip closes the inlet needle valve.

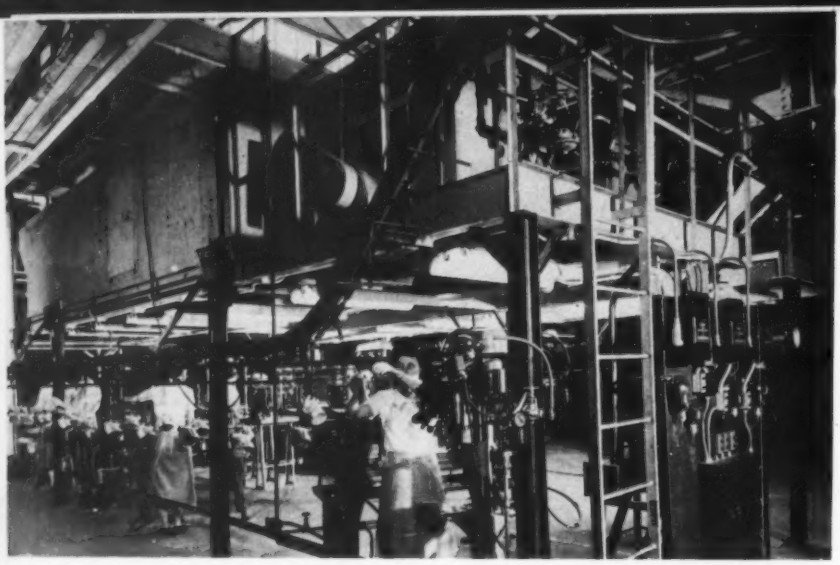
Corrosion Problem

The valve bodies used by A-P in the manufacture of the various sizes and types of controls available are cast of iron, zinc, or aluminum. In service, all of these materials are subject to corrosion caused by chemical agents, such as sulfates, carried by the water which is frequently present in the oil supply of a heating unit.

In an effort to overcome this corrosion problem by means of a single coating which would not only make the castings corrosion resistant but would also eliminate the need for subsequent painting operations, A-P carried out extensive studies of numerous protective finishes. This investigation, conducted over a long period by A-P engineers in cooperation with various finish suppliers, eventually led to the decision to use vinyl coating.

The resistance of the vinyl coating to dilute sulfuric acid was demonstrated by tests in which finished controls in simulated service were operated for ten weeks with a half-and-half mixture of fuel oil and water containing a 0.3% sulfuric acid solution. In other tests, the plastic coating demonstrated its ability to withstand being boiled for a week in a 5% solution of sulfuric acid without impairment.

Having decided upon the vinyl coating as the best answer to the problems of corrosion resistance and



Trimmed metal bodies are hung on overhead conveyor at start of finishing sequence. Bodies are first carried through various cleaning, rinsing, and drying operations

finishing, A-P thereupon went ahead with the installation of a fully integrated system to handle the application of the new coating. The considerable expenditure involved in setting up this new system, which recently was placed in full operation, is believed by the company to have been immediately offset by the many advantages of the new process as well as by the fact that it assures A-P customers of a much higher quality product.

Installation

Five fundamental considerations were involved in working out details of the installation.

1) The company required a fast, efficient method that would clean and bake the metal castings and also provide a surface properly etched to insure a good sealing bond.

2) Provision had to be made for cooling each casting to correct temperatures so that the pores of the metal would readily absorb the vinyl coating.

3) The new process required a final cure which would drive out volatiles without creating bubbles in the finish either on the inside or outside of the parts.

4) The equipment had to provide for processing both inside and outside with the end result of eliminating air pockets and providing 100% coverage.

5) The process could not, in any way, delay production line sequence or movement by requiring time-delaying handling or drying.

The entire installation was condensed into a floor area of approximately 2000 sq. feet. A chain conveyor was set up to keep the castings moving at an even pace through each step of the process, with treatment areas properly spaced so that one step was completed before the metal bodies moved on to the next station. A two-temperature overhead curing oven was designed and provision made for proper mixture and temperature control of the vinyl coating solution.

Under the new system, raw, unmachined control castings are delivered to A-P by outside suppliers. Prior to cleaning and coating, they are faced and trimmed by a battery of four lathe operators, after which they are hung on conveyor hooks which hold them at the proper angle to eliminate any possibility of drip-bubbles. Carried by the overhead conveyor—arranged so as to permit units to be suspended from both sides—the parts first pass through a tank where a combination cleaner and phosphatizer is applied to facilitate adhesion of the vinyl solution. The parts next pass through a fog chamber where they are exposed to a fine mist of tap water, and on to the rinse tank containing a dilute chromic acid solution. In the next stage of the operation, the parts pass through a drying chamber where they are exposed to 350° F. air for about 12 minutes.

Before cooling down completely, the valve bodies are carried into the dip tank where the vinyl solution is applied. Baffles in the bottom of the tank are so arranged that the parts shift position as they pass through, thereby exposing all surfaces to the coating material. The vinyl solution, at room temperature, is kept in constant motion by means of a circulating pump.

Photos courtesy A-P Controls Corp.

Cleaned parts are then conveyed to dip tank where they are automatically immersed in the specially formulated vinyl solution. The coated bodies (foreground) drain and air-dry as they emerge from dip tank

Viscosity Tests

Viscosity tests are presently run several times daily and solvent is added as required to maintain the solution at the correct consistency. Semi-automatic viscosity regulators, however, will be installed in the near future.

Extinguisher nozzles mounted directly in the coating chamber pro-

vide built-in protection against possible fire hazards.

Emerging from the vinyl solution, the parts drain and air-dry for about two min., then enter the oven area for prebaking at a temperature of 150° F. Here they are exposed for about 10 min., during which time solvents are eliminated, and are then transferred to another section where they are subjected for another 10 min. to 250° F. temperature which cures the vinyl coating. The complete dipping and oven installation is vented through the roof by means of a powerful exhaust system which serves to eliminate all solvent fumes.

Leakage Tests

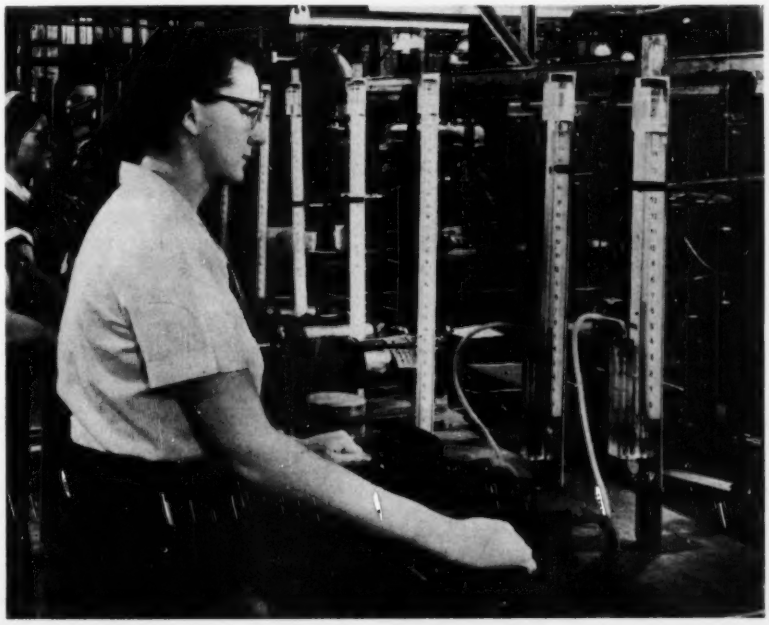
As the finished castings move out of the curing section, they are removed from the continuous conveyor line and tested for leaks with a series of manometers. These tests involve sealing off different sections of the castings and placing them under vacuum. Any drop in a manometer reading indicates porosity through the wall of the part. Following the leak-check, all drilling and tapping of the parts is completed and chips are cleaned off. After the valve bodies pass through the cleaning station, they end up in the storage bay at the head of the basic assembly line on which floats, strainers, needle valves, and other parts will be installed.

The finished corrosion-resistant vinyl coating, averaging about 0.0008 in. in thickness, has a glossy, attractive appearance and is highly resistant to abrasion, permitting the parts to be handled without fear of chipping or damaging the finish. Most of the valve bodies are sealed with a dark brown coating, although white and black coatings are also used to harmonize with the modern colors used with several types of present-day heating equipment.

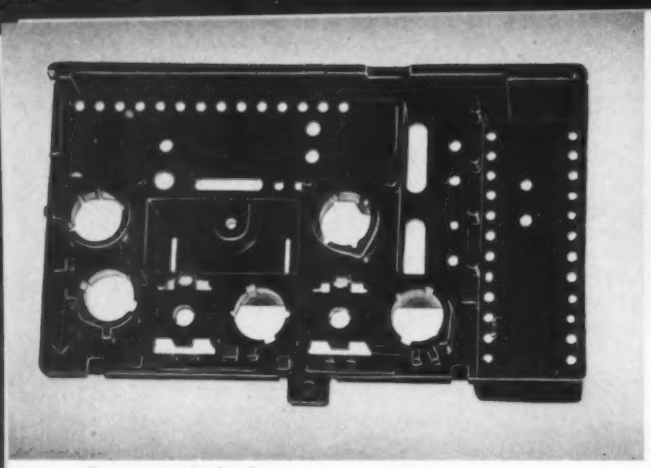
Through adoption of the new vinyl coating, A-P is now able to exert complete quality control of the oil valve bodies from the time they leave the casting vendor up to the time that they enter the assembly line operation.

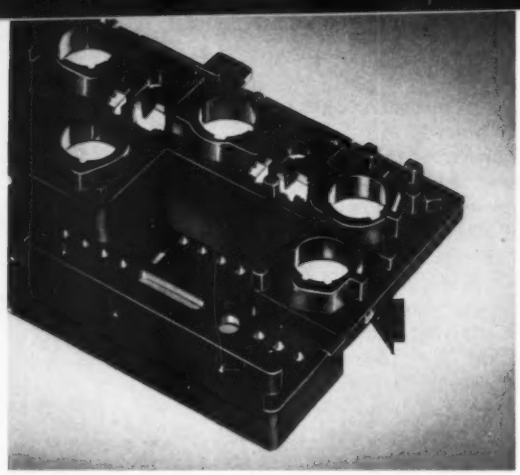
CREDITS: Oven and tanks designed by Dispatch Oven Co., Minneapolis, Minn.; cleaner supplied by Oakite Co., New York, N. Y.; conveyor belt by Conveyor Systems, Inc., Chicago, Ill.; controls by Wheelco Instruments Co., Div. Barber Colman Co., Rockford, Ill.

After exposure in curing oven to temperatures of 150° F. for prebaking and 250° F. for final cure, bodies are carried (right) down to floor level



Cured castings are removed from conveyor line and passed on to testing station where workers, using a series of manometers, check each unit for porosity





Photos courtesy Bakelite Co.

Pieces as intricate as complicated radio chassis are cleanly molded in one piece with new general-purpose phenolic

Despite small sprue (arrow), molded chassis has no visible weld lines and exhibits good mechanical strength

Modernized

A NEW general-purpose phenolic molding compound, reported to have good blend-to-blend uniformity coupled with increased molding latitude, has been introduced by Bakelite Co. under the code designation BMG-5000.

The material is produced in black or brown on specially engineered automatic semi-continuous equipment and is closely quality controlled during manufacture. Statistical control charts are maintained on each property and are so evaluated that any tendency to drift from normal can be immediately detected and the product kept within established limits. Similar statistical control methods are applied to the manufacture of the resins that are used in the preparation of this new phenolic molding material.

This production technique has resulted in a material reported to be equally suitable for use in compression, transfer, or plunger molding and offering continued maximum production output, maintenance of critical dimensions in the molded piece, and glossy, lustrous black surfaces.

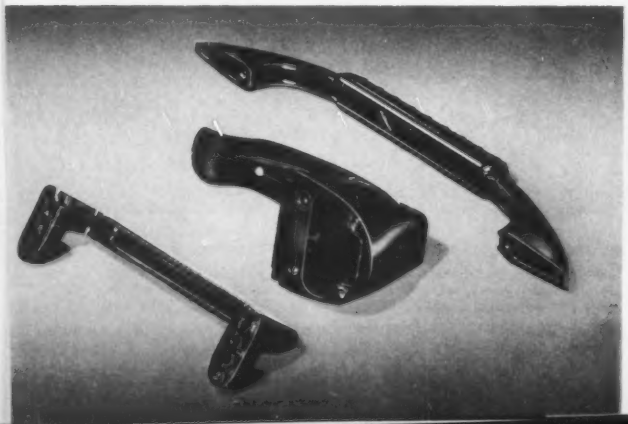
Flow Properties

BMG-5000 is claimed to fill out molds at pressures lower than those needed for general-purpose materials of comparable plasticities. It exhibits better flow properties, particularly in the medium-flow-type pieces in which the molding material must flow into long, thin-section areas. Even with a minimum of molding pressures, maximum closing speeds are possible.

The excellent flow properties of the new material are also reported to assure freedom from weld lines in molding intricate pieces. The complicated radio chassis illustrated on this page, for example, measures 6⅜ in. long, 3⅝ in. wide, and 1¾ in. at its highest point and contains 100 holes and depressions, yet has no visible weld lines and exhibits good mechanical strength when plunger molded of BMG-5000.

Despite the small sprue which is used in molding this chassis, the material flowed freely and uniformly around each of the many core pins. The chassis was molded in an over-all time of approximately 2 minutes. A charge of 146.5 g. of BMG-5000 was transferred through the runners to the cavity by way

Curing time for small roaster handle, iron handle, and large roaster handle (left to right) is considerably reduced when using new general-purpose phenolic. Although wall sections of handles vary in thickness (see bottom views, left), all cured without warping



of a ⅛-in. diameter orifice. The closing time was 10 seconds. Borderline cure—there was no sign of blistering when the clamp was opened—was obtained in 23.5 sec. and production cure was obtained in 29.5 seconds.

Dimensional Stability

The over-all dimensional stability of BMG-5000 coupled with its good rigidity at hot discharge from the mold further contributes to the value of the general-purpose phenolic as a molding material for intricate pieces. Where parts must be interchangeable, particularly in small electrical wiring devices such as the switch box case illustrated, dimensional stability both during and after molding, run-to-run uniformity of molding material, and freedom from warpage take on added importance. In this application, the switch box covers are compression molded and must be interchangeable to fit any of the switch box cases. The cases themselves are plunger molded. Good rigidity of the molding compound at hot discharge facilitates free and rapid release from the mold.

At the same time, since this switch box is mass-produced—24 covers are molded at a time—production economy is another factor.

Work Horse

Rapid Cure

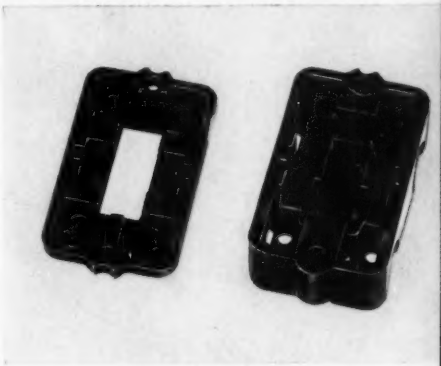
Three of the basic advantages of BMG-5000—its speed of cure, its ability to be preheated at higher temperatures for longer periods of time than was possible with other general-purpose materials, and its dimensional stability—make it particularly adaptable to the molding of all types of handles.

The three handle applications illustrated typify the results of molding the new material. The large roaster handle, for example, cured blister-free in 21 sec., instead of the 30 sec. required with the molding material formerly used. The molded piece was rigid at discharge and did not stick to the mold cavity—noteworthy behavior at so short a cycle.

The electric iron handle and the small roaster handle, despite their relatively thick and thin sections, did not warp on curing when molded of BMG-5000. The electric iron handle was molded blister-free in 46 seconds. Experimentally, the preheat time for this handle was successfully increased to as much as 188 sec. without any adverse effects on the molded piece; there was no tendency to precure in the preheater.

Parts molded of the new phenolic material—under all types of molding conditions—have a uniform high gloss, high luster surface free from haze and surface defects.

Table I, below, lists the average physical, chemical, and electrical properties of the new material.



Switch box case is plunger molded of phenolic; cover is compression molded

Table I—Bakelite General-Purpose Phenolic Molding Material BMG-5000

Properties	*Average Values* Black	Brown
Bulk factor (D392-38)	2.44	2.34
Tableting quality—Can be tableted satisfactorily in the usual tableting equipment		
Molding shrinkage, in./in. (WC-56-F)	0.0048	—
Dielectric strength (D149-44)		
Short time, v./mil.	379	350
Volume resistivity, megohm-cms. (D257-46)	3.0×10^6	10×10^6
Dielectric constant (D150-47T)		
60 cycles	5.36	5.9
1000 cycles	5.21	5.4
1,000,000 cycles	4.64	4.7
Power factor (D150-47T)		
60 cycles	0.066	0.07
1000 cycles	0.038	0.05
1,000,000 cycles	0.034	0.04
Molded specific gravity (D-392-38)	1.34	1.38
Heat distortion temp. (D648-45T), °F.	329	—
Heat resistance—molded parts ordinarily should not be exposed to temperatures in excess of 300° F.		
Water absorption (D570-42), % gain in weight	0.42	0.42
Izod impact strength (D256-47T), ft. lb./in. of notch	0.31	0.29
Compressive strength (D695-44T), p.s.i.	36,150	36,000
Tensile strength (D651-48) (⅛ in.), p.s.i.	8680	9300
Flexural strength (D790-45T), p.s.i.	10,070	10,300
Modulus of elasticity in flexure (D790-45T), p.s.i.	9.5×10^5	10×10^5

PLASTICS

Cover and Measure Cup for Coffee Can

Coffee can cover with removable measuring cup is molded entirely of polyethylene. The unit, called Measure Seal, fits all standard-size coffee cans and provides an air-tight seal for the contents. Unlike the conventional metal lid which it replaces, the polyethylene closure need not be removed for access to the coffee. The measuring cup, which has a capacity of about one tablespoon, is simply slipped off the pouring spout and a measured amount is poured out.

The snug fitting Measure Seal covers the sharp edges of the metal coffee can and will not slip off if the can is accidentally dropped.

Four covers and four measuring cups are simultaneously molded on a 12-oz. injection molding machine using an 8-cavity mold sprued from the side. Closures are available in red, yellow, and natural.

CREDITS: Molded for Greene Laboratories, 70 Middle Neck Rd., Great Neck, L.I., N.Y., by Leaf Plastics, Inc., Yonkers, N.Y. Polyethylene supplied by Bakelite Co., New York, N.Y., and E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Non-Corrosive Diaphragm-Type Shower Head

Diaphragm-type shower head molded of phenolic will not clog or cake with lime or corrode in contact with water. Changes in water pressure act upon a flexible rubber diaphragm set into the head to automatically break up lime deposits. Since air is mixed with water in the shower head, the unit runs on 40 to 60% less water than is required for conventional models. Adjustment of a phenolic knob located on the face of the shower head controls the width and intensity of the spray.

The chip-proof phenolic body will not fade nor will it expand or contract with varying water temperatures. All metal parts are plated to resist the corrosive effects of chemical action of the water.

Shower head body is compression molded in a 4-cavity mold. The ball and socket unit is threaded to the phenolic body by a knurled chromium brass collar.

CREDITS: Molded by Imperial Molded Products Corp., Chicago, Ill., for Magic Fountain Inc., Waltham, Mass. Phenolic supplied by Durez Plastics & Chemicals, Inc., N. Tonawanda, N.Y., and Bakelite Co., New York, N.Y.

PRODUCTS

Styrene Baby Bottle Holder

Many of mother's baby feeding problems have been solved with the introduction of a baby bottle holder called Easy Nurser. With the exception of two metal bolts and wing nuts, the holder is molded entirely of styrene. Designed to accommodate all standard bottles, it mounts directly to any one of the upright bars of the baby crib, freeing mother's hands for other jobs during nursing time. The durable unit will not stain or chip and can easily be cleaned.

To mount the holder, brackets are first fitted around either side of the crib bar and are held in place by the bolts and nuts. The holder proper has a molded-in arm with a straight bar at one end which easily slides into a slot in the mounting bracket assembly.

The Easy Nurser is injection molded on a 12-oz. molding machine using a 3-cavity mold.

CREDITS: Molded by Kusan Inc., Plastics Div., Nashville, Tenn., for Cherokee Products, 607 Main St., Nashville 6, Tenn. Styrene alloy supplied by The Dow Chemical Co., Midland, Mich.

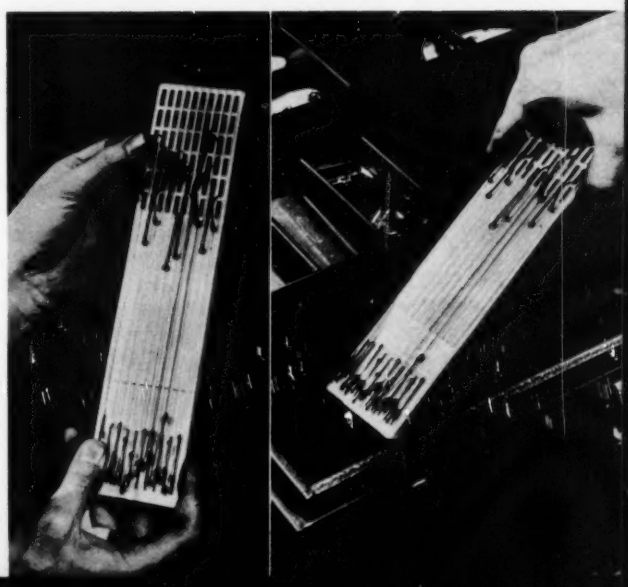
Spring-Actuated Fishing Hook Holder

Fishing hook holder, molded of styrene, is light enough to float, will resist rust and rot in the presence of salt or fresh water, and can accommodate approximately 20 hooks and snells of different lengths and sizes—ten on each side. Hooks are slipped into molded-in slots at one end of the holder with the barbs facing towards the inside of each slot. At the other end of the holder, the loop of the leader is slipped over a spring-actuated slider which serves to keep each hook and snell under tension.

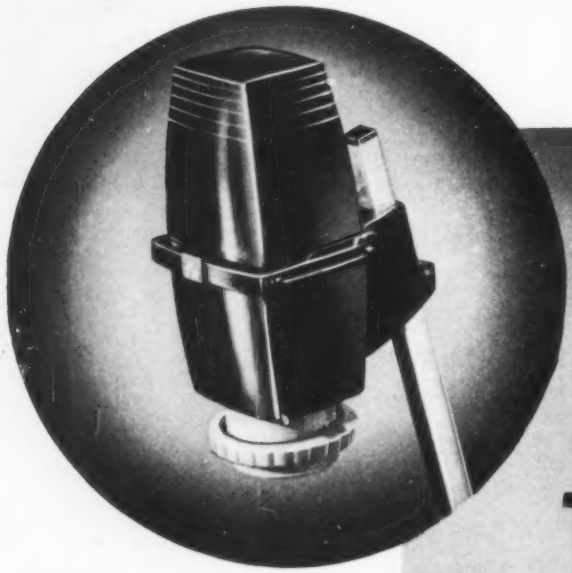
The unit can be conveniently carried in tackle box or coat pocket without snagging hands or clothing. An 11 in. long scale molded into the side of the holder is used for measuring the size of the fish.

The fishing hook holder is injection molded in a 3-cavity mold mounted on an 8-oz. machine. The 20 steel springs in the grooved sections are held in place when the front and back halves of the holder are cemented together.

CREDITS: Manufactured by Lewis E. Hamel Co., Inc., 225 Central Ave., Rochester 5, N.Y. Styrene supplied by Bakelite Co., New York, N.Y.



PROGRESS



Lightweight all-plastics photo enlarger is designed for compactness

Courtesy The FR Corp.

As first step in simple operation of enlarger, negative to be enlarged is placed in a molded styrene carrier and inserted in a slot between lamp housing and lens housing

MUCH of the progress made in recent years in the design and application of photographic equipment—from complex cameras to simple developing tanks—can be traced to an ever-increasing use of plastics materials.

Latest to join this impressive list of successful plastics applications is a major piece of photographic equipment that has long resisted modernization—the photo enlarger. The result of 22 months of research and engineering by The FR Corp., New York, N.Y., the streamlined, easy-to-use plastics enlarger presents a striking contrast in size and design to the metal models used in the past.

Four Objectives

In deciding upon this radical switch from conventional metal stampings to plastics. The FR Corp., a leading supplier of photographic equipment, had four objectives in mind:

1) To reach an expanded market in the low price range without sacrificing quality.

2) To reduce weight for ease in handling.

3) To simplify the operation of the photo enlarger.

4) To design a compact, smartly styled unit.

On all four counts, the plastics enlarger lived up to expectations.

The completed enlarger has only three basic parts—a molded phenolic housing for the 50-w. lamp that serves as a light source; a molded styrene lens barrel; and a molded styrene lens housing. The entire unit sells for only $25—about $15 to $20 less than a comparable metal model. The total weight of the enlarger, exclusive of the board and column which serves as the support is 2 lb.; shipping weight is 8 lb.—approximately half the weight of the metal model.

Because of the design potential of plastics materials, the engineers of FR were able to create a handsome piece of equipment with fresh, smart lines that would be impossible to obtain with metal stampings. The enlarger unit stands, exclusive of support column, only 10. in. high.

Integral Colors

Since the lustrous black and red colors of the unit are integral to the molded parts, there is no peeling paint, and no unsightly scratches can mar the appearance of the enlarger. The durable unit will also resist corrosion and can easily be wiped clean with a damp cloth.

Perhaps the biggest advantage de-

IN PHOTO ENLARGERS

Plastics components make possible refinements in design, lower cost, lighter weight, and simplified operation

rived from switching to plastics, however, was the ability to mold the various parts in one piece, complete with all the lugs, grilles, and irregular openings essential to assembly. Each molded part is designed to interlock, nest, or join with adjacent parts so that final assembly becomes an efficient and inexpensive operation.

Fabricated metal grilles and housings, similar in design to those molded of plastics, would require the time-consuming use of spot-welding and riveting, as well as expensive dies and fixtures.

Simple Operation

The plastics photo enlarger is also designed for simplicity in use. The photographer first places the negative in a styrene carrier, together with a mask and a sheet of opal glass. The carrier is inserted into a slot in the enlarger, located approximately mid-way between the light source and the lenses.

The image size can be adjusted by sliding the enlarger up and down on the column support until the desired dimensions have been reached. To focus the image, the lens barrel is moved in or out of the lens housing with a twisting motion.

When the photo enlarger is not in use, the metal column support folds down to the baseboard so that the entire unit can be stored in a minimum of space.

Lamp Housing

Because of the heat generated by the light source, the upper housing of the enlarger is compression molded of general-purpose phenolic. The entire housing, including a grille on the top surface of the unit, is molded in one piece. A large rectangular opening into which a die cast metal louver is fitted, is molded into the rear half of the housing. In use, the assembly is convection cooled by air circulating through the passage between the grille and louver.

A molded-in depressed seat in the lower front half of the lamp housing is designed to receive a small metal insignia stamped with the company's trademark. This insignia is also used to lock the upper lamp housing and the lower lens housing together. Behind the seat for the insignia is a small opening into which a lug molded-into the lens housing is snugly fitted. The bottom of the metal insignia is crimped around the edge of the housing to hold this lug in place. To secure the other end of the two housings together, the lower half of a steel spring in the lens housing is pulled back and inserted into a ridge molded-into one edge of the lamp housing.

Lens Housing

The lens housing is molded of medium-impact styrene, also in one piece. This part consists of the housing proper and a rear section in which the steel spring and an opening for the metal column support is located. Since the column support is

(*To page* 180)

Lamp housing is phenolic (top left); lens housing (top right) and barrel, carrier, and shoe (bottom) are styrene

Lamp housing has molded-in opening into which metal louver is fitted. Lens housing has a molded-in recess in its base into which a molded styrene lens barrel sleeve is solvent-bonded

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How to Make Flexible Model Molds

by Edward Ferrari†

THE process of casting plastics in flexible elastomer molds with a high degree of accuracy, thin wall sections where desired, and the ability to make many pieces from a single mold has recently been greatly improved. Previously, parts or models were made in plaster, which was subject to breakage, or they were laboriously hogged out of blocks of material, or sometimes sand cast in metal with resulting finishing problems.

Plastics pieces have been cast in plaster molds, but mold-life is very short. Undercuts are not possible except by complex mold construction. Flexible molds previously developed were subject to high shrinkage, and accuracy was not obtainable.

When it is necessary to cast many pieces requiring intricacy of detail in their external appearance or many mechanical requirements in the core such as webs, bosses, etc., it has been found that a flexible mold made from an elastomer material gives the best service.

The basic problems involved in the use of this material are its flexibility and the tendency to shrinkage in some types of molds.

Controlled Flexibility

The flexibility of the material is the quality it possesses which is most desirable. On the other hand, it can also be a handicap if it is not properly controlled. A small mold can be made with sufficient wall thickness so that it will retain its original shape and not warp, twist, or sag. However, it is usually advisable to encase the elastomer in plaster after it is cured and before it is removed from the pattern.

Shrinkage is the other, more seri-

Product designing demands a close relationship between appearance and function. The appearance approach begins with preliminary sketches, proceeds through three-dimensional models and more detailed drawings to finished models incorporating either simulated or actual materials which will finally be used in production.

Next step in product design involves a survey of consumer reaction. This means that the finished models must be put on display, sometimes handled by the public, and transported from place to place. Consequently, the prototype needs to be as durable as a production item.

Plaster is not a suitable material for such prototypes, because the percentage of breakage is too high. This brought out the evident need for a method or process of translating the plaster model into a durable material such as plastic without increasing cost too greatly.

The answer was found in the use of durable plastics cast in flexible molds such as are described in the accompanying article. Many prototype reproductions can be made from a single mold of this type with a high degree of accuracy.

Three examples of plastics prototype parts cast in flexible molds, together with the products in which they are used. Flexible molds offer an economical method of producing such prototypes in large numbers and in durable materials

Courtesy General Electric Co.

* Reg. U. S. Pat. Off.
† Appearance Design Section, Small Appliance Div., General Electric Co., Bridgeport, Conn.

FIG. 1

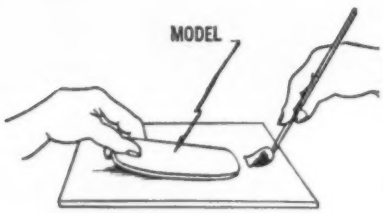


FIG. 2

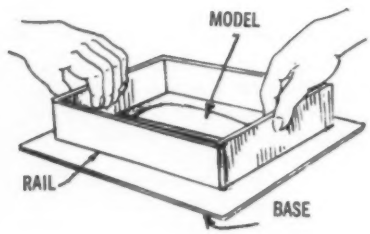


FIG. 3

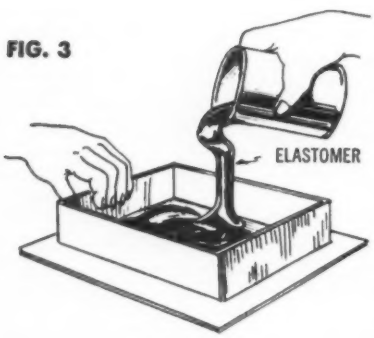


FIG. 4

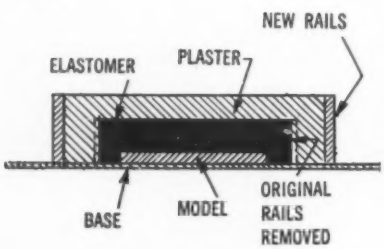
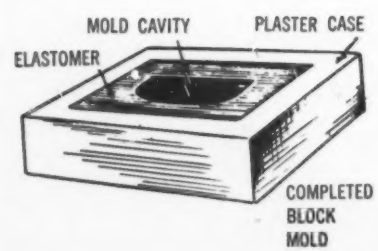


FIG. 5



ous problem encountered in the use of this material. It increases as the over-all dimensions of the pattern increase. It can be controlled by first making an outer plaster case over the pattern which allows the proper space to contain the inner flexible elastomer mold. The case is so designed that it contains the elastomer in a series of locks. keys, and registry points which prevent it from shrinking or distorting, thus maintaining the accuracy of dimension of the pattern.

A wide variety of parts have been cast in flexible molds. They include: electric iron handles, electric clock and instrument cases, motor housings for fans, and handles and miscellaneous parts for roasters, toasters, grilles, percolators, etc.

MOLD MAKING

In order to fasten the pattern or model onto a background, place a thin layer of elastomer on the background and embed the pattern in it (Fig. 1). Place a rail of thin metal, wood, or masonite around the model, the height of which should be from ¼ to ⅜ in. above the highest point of the model (Fig. 2). Seal all joints of the fence with elastomer. This assembly is then placed in an oven at approximately 180 to 220° F. When the elastomer is cured, remove the assembly from the oven and, while still hot, brush on an even coat of a good paste wax such as Johnson's wax. If the pattern is a porous material such as plaster or wood, the wax should be a little more generously applied in order to seal the surface and insure proper parting of mold and pattern.

Fill the assembly with elastomer to the top of the fence (Fig. 3) and return it to the oven at about 200° F. It should be left in the oven approximately 10 min. for every ¼ in. of thickness. If the pattern is such in character of detail that it has long or thin draws in the mold or it is to be used for many casts, place it back in a moderate oven (about 180° F.) for approximately 4 hours. This will tend to produce a mold which is much more resistant to tearing. When the mold is thoroughly cured, remove it from the oven and cool it in water. Allow the mold to cool thoroughly before placing it in use. Before removing the elastomer from the pattern, remove the rail from the elastomer and trim away all excess material from around the mold.

Plaster Case

Since the mold material is flexible in nature, it is always advisable to enclose it in a plaster case. In order to do this, build another rail around the mold, leaving space enough between the rail and mold, and of sufficient height above the mold, to insure proper thickness of the plaster case. Mix the plaster and pour it over the elastomer mold until it is covered, then place several layers of AA mosquito netting for reinforcement in the plaster before filling the remaining space to the top of the fence.

When the plaster is partially set, level it off with a metal straightedge (Fig. 4). After the plaster has set, remove it from the elastomer, then remove the elastomer from the pattern, placing it back in the plaster case (Fig. 5).

The method as it is given up to this point is only applicable to small molds not more than 2 or 3 in. square. Beyond this dimension it is necessary to design a plaster case which will not only help retain the original shape of the elastomer, but also

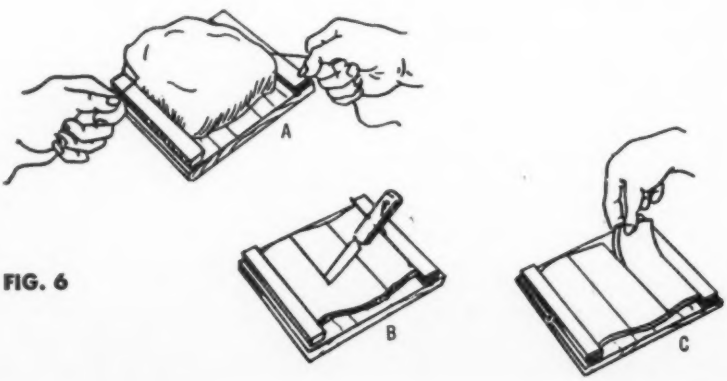


FIG. 6

FIG. 7

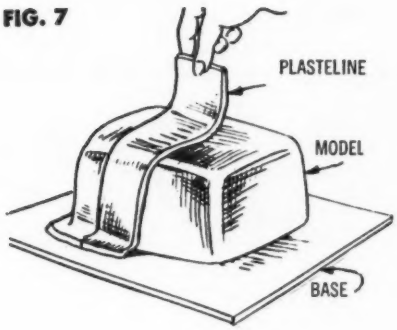


FIG. 8

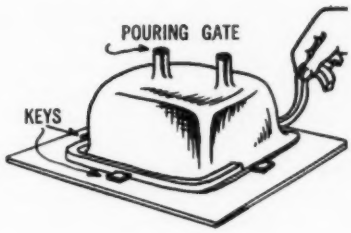
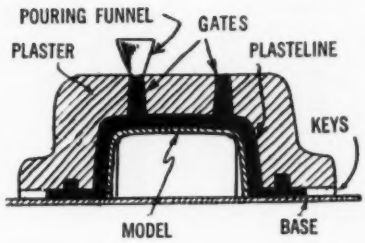


FIG. 9



control any shrinkages that may occur. This is accomplished by making the case first, then pouring the elastomer into the case until it is full, and curing the entire assembly in the oven at 200° F. temperature. The process of making the case is as follows:

Plasteline or modelling clay is formed into a sheet ¼ in. in thickness by rolling or cutting it (Fig. 6) on a marble slab or a smooth wet plaster slab. Dust the slab and roller with soapstone to prevent sticking. The sheets of plasteline are then pressed over the model until they make contact with the model on all of its surfaces (Fig. 7).

The next operation is important in that it is the means of controlling any tendency to shrink on the part of the elastomer. Where the plasteline sheets meet with the background on which the pattern is mounted, a strip of plasteline, about ⅜ in. sq. is placed (Fig. 8) on the intersection all around the pattern. Then the pouring gate is located at the highest point of the pattern; here a cylinder of plasteline about ¾ in. in diameter and ¾ in. in height is placed.

In the centers of these cylinders, place wooden dowels fastened to the pattern in such a manner that they will not be displaced when the elastomer is poured. These will serve as the pouring gate and vents for the plastic when a closed two-part mold is used. Likewise, smaller cylinders are placed for venting the mold on any other high points on the pattern.

Registration Keys

In order to relocate the case in relation to the pattern, keys made of pieces of wood cut in the shape of a triangle are placed around the square strip of plasteline. Four or six of them should be sufficient (Fig. 8). When this is done, mix a primary coat of A-11 Hydrocal plaster and splash it on the entire surface of the plasteline. When this is partially set, mix some more A-11 plaster and apply it with successive layers of AA mosquito netting until a laminate about ½ in. in thickness has been built up (Fig. 9). If further reinforcement is necessary, use ¼-in. iron bar stock bound on with AA netting, cut in strips, dipped in the plaster, and placed over the irons.

When the plaster case is thoroughly set, remove it from the pattern and remove all the plasteline from it and the pattern. Sandpaper any roughness on the inside surface of the case and remove any sharp undercuts. The mold must then be thoroughly dried in an open oven or under infra-red lights at a temperature not exceeding 150° F. When the mold is dry and while it is still warm, brush on a generous coating of Johnson's paste wax or any high melting point wax. Likewise, warm the pattern and brush the wax on, taking care not to leave any excess on the surface as this will produce imperfections in the mold. Replace the case over the pattern using the keys as a guide. Seal the seam between the background and the case either with elastomer (which must be cured before pouring the mold) or with plaster (which should be allowed to set).

Place a few weights on top of the mold to counteract the lifting power created by the head pressure of the liquid elastomer, or clamp the case to the base with C clamps. After the case has been filled through the pouring gate (Fig. 10), allow the assembly to stand until all entrapped air has escaped. Then place it in the oven at 200° F., allowing sufficient time for the heat to penetrate the plaster case and model to cure the elastomer.

When it is necessary to make a

FIG. 10

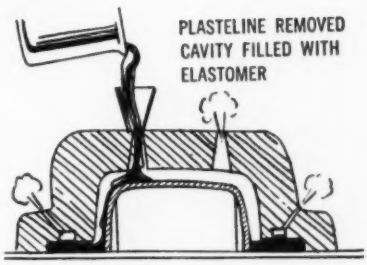


FIG. 11

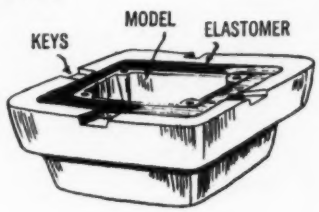


FIG. 12

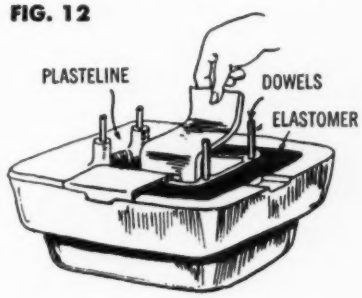


FIG. 13

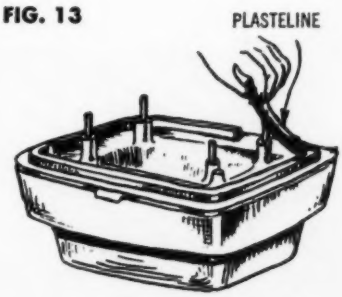


FIG. 14

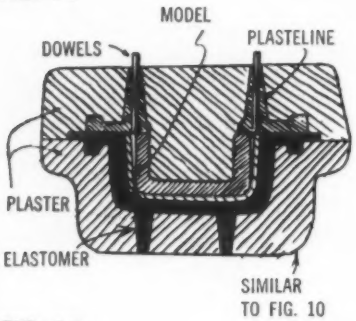


FIG. 15

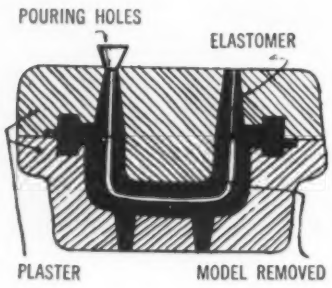


FIG. 16

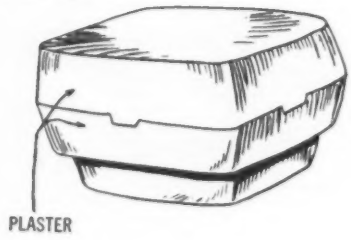


FIG. 17

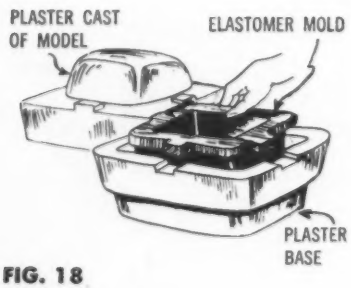
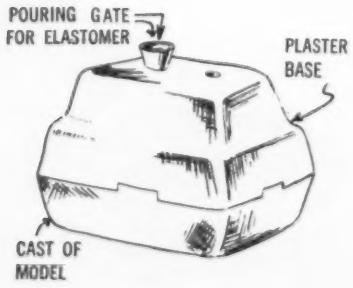


FIG. 18



two-part mold, the point of departure is from the first half. With the model in place in the first half of the elastomer mold and plaster case (Fig. 11) place wooden dowels which will form the pouring gate and vents for the casting resin. Place a thickness of plasteline or clay over the model and around the dowels, stopping at the edge of the elastomer of the first half of the mold as shown in Fig. 12.

Around the edge of this plasteline or clay thickness add a square strip of plasteline or clay (Fig. 13). This will form the lock which controls the tendency to shrink on the part of the elastomer. After lubricating the plaster case of the first half with a parting agent, make a plaster case for the second half on this assembly (Fig. 14).

When the plaster is set, remove the case of the second half. Remove all the plasteline or clay from the case and model. Leave the dowels on the model. With the case and model

FIG. 19

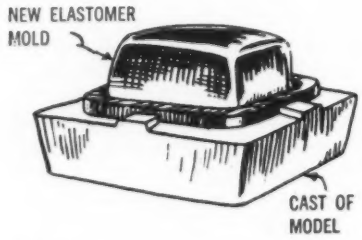


FIG. 20

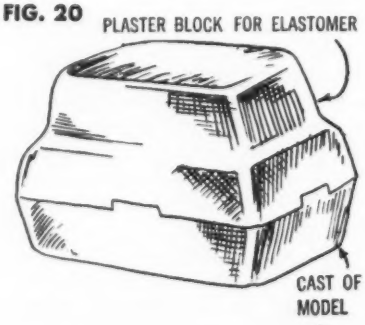


FIG. 21

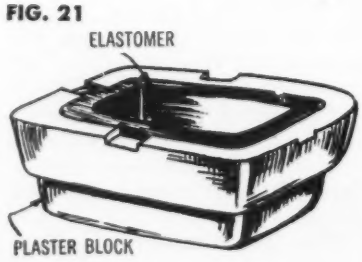
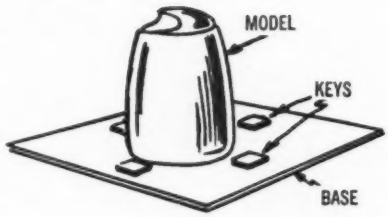


FIG. 22



prepared in the same manner as is described in making the first half, pour the elastomer for the second half and cure it. When this is done, remove the case, then the elastomer, and then the model. Pull the dowels out of the elastomer, brush a coat of wax on the plaster cases and, with the two elastomer molds replaced in the cases, put them together again and the mold is ready to be filled with the casting resin as shown in (Fig. 15.).

Master Models

If a number of molds are desired, make an A-11 plaster cast in each half mold wide enough and thick enough to include the shoulder of the original case (Fig. 16).

Remove this cast from the case, then remove the original elastomer (Fig. 17). Replace the original case on the plaster cast after brushing each with a coat of wax. Fill the assembly with elastomer and cure (Fig. 18).

When the elastomer is cured, remove the case, leaving the elastomer on the model (Fig. 19). Over this elastomer make a new plaster case (Fig. 20). When the plaster is set, remove the new case and the new elastomer mold from the model. Replace the new elastomer mold in the new plaster case, and the new mold assembly is ready for use (Fig. 21).

Composite Molds

Sometimes, when the exterior of a model is simple in detail and only one or two casts are necessary, it is expedient to make a plaster piece mold of the exterior and an elastomer of the core or inside. In doing so, it must be taken into account that most cast plastics, regardless of the parting medium used, have a tendency to adhere to a mold surface. Consequently, it is difficult to draw the cast out of a one-piece cavity because in doing so it must draw

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FIG. 23

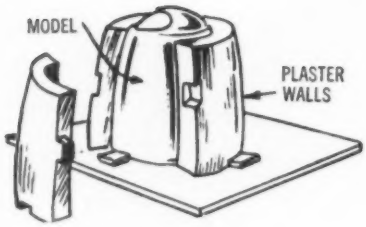


FIG. 24

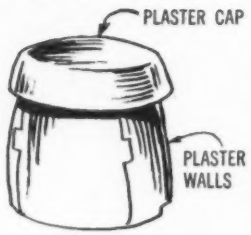
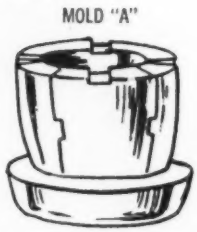


FIG. 25



along the surface with which it makes contact. However, if a piece mold is made so that each piece draws away from the cast in a direction normal to its surface, no difficulty will be encountered. The procedure for making the second half of the mold is the same as for a mold made entirely of elastomer.

After the plaster has been thoroughly dried, apply a very light coat of orange shellac and then wax the entire mold. This will insure proper parting. Another method is to apply a light coat of elastomer #21 over the entire surface of the plaster mold which is then subjected to cure at 180° F.

Sometimes it is convenient to make or use a solid model from which a hollow cast with a controlled wall thickness is made. This can be accomplished during the mold making operation in the following sequence of steps.

Make a plaster piece mold of the model as shown in Figs. 22 to 25. Line this mold with sheets of pattern wax until the desired wall thickness is built up (Fig. 26). If necessary, incorporate whatever ribs, webs, or bosses are desired in the core and then make a plaster cast which will serve as the pattern for the core (Figs. 27 and 28). This pattern must be related to the plaster mold by the means of locating keys.

Remove the pattern of the core and make a plaster mold over it. (Figs. 29 and 30). Place the plasteline thickness necessary for the elastomer in this mold (Fig. 31), and then make a core in it.

After removing the plaster case and all of the plasteline from the mold, apply a coat of wax and replace the case in the mold and pour the elastomer. (Figs. 32 and 33).

The result when removed from the mold will be an elastomer covered core which is related by the keys to the original plaster piece mold (Figs. 34 and 35).

In all of these steps, be sure to retain the registry established by the keys in the original plaster mold.

TYPES OF PLASTICS USED

Two types of resins are used in casting models and patterns; they are phenolic and epoxy resins.

Phenolics. In order to convert a liquid phenolic resin into a solid, the action of a catalyst is necessary. The catalyst, or accelerator as it is sometimes called, induces a reaction in the resin which forms larger and larger molecules which eventually results in a solid state.

The resin described here is ARC 120 with accelerator #1033 and #1033A. The fillers are acid-washed asbestos and ground cork.

In general, the procedures and proportions established by the manufacturer should be followed. However, it was found that in casting models with thin wall sections, the mixture which gave the best results was of the following proportions:

Parts by Weight
ARC 120 resin—100
#1033 accelerator—8.5
#1033 A accelerator—1.5
asbestos filler—0.03

The filler was added to the resin and permitted to stand with a few drops of alcohol on its surface to facilitate the escapement of entrapped air in the mixture. Then add the accelerators in the order given and stir until all the ingredients are thoroughly mixed. Care must be taken during the process of mixing to avoid entrapping air bubbles which would tend to make a porous cast.

In pouring, place a funnel in the gate and pour as rapidly as possible since the mixture becomes viscous

(*To page* 103)

FIG. 26

FIG. 27

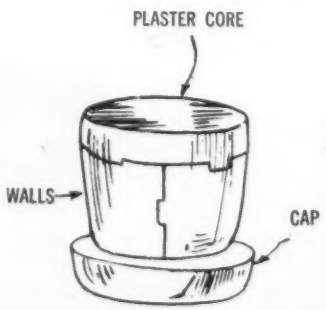
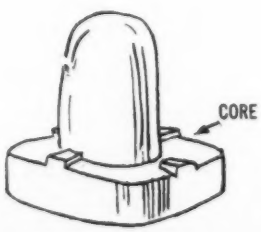
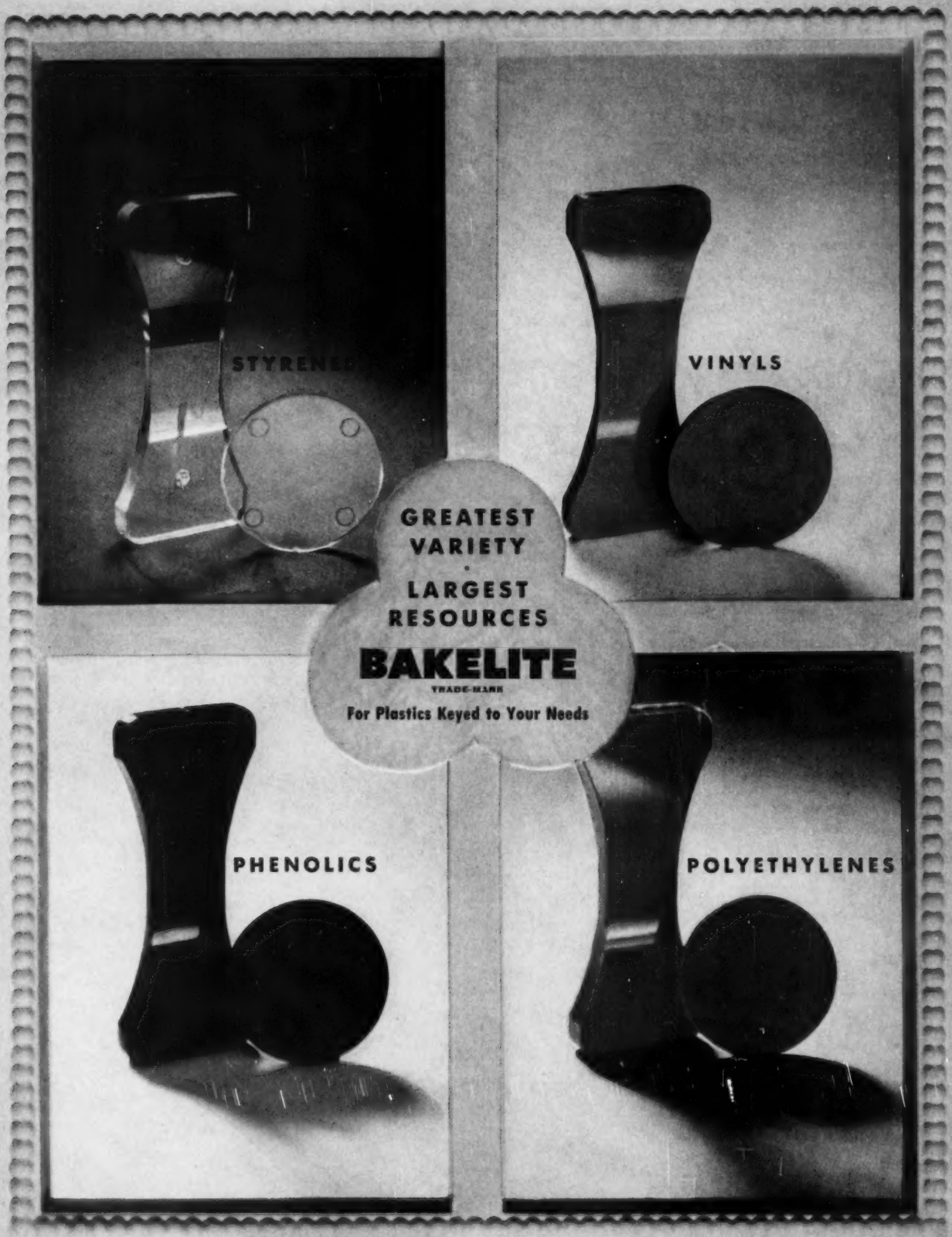


FIG. 28

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BAKELITE PHENOLIC PLASTICS

Washing machine agitator molded of BAKELITE Phenolic Plastics for the **Whirlpool Corporation** by Plastic Service Corporation, La Porte, Ind.

Satin-smooth, snag-proof finish is a big feature of this washing machine agitator. Molded of BAKELITE *water-resistant, improved-impact* Phenolic Plastic, it defies scalding water, soaps, bleaches and detergents.

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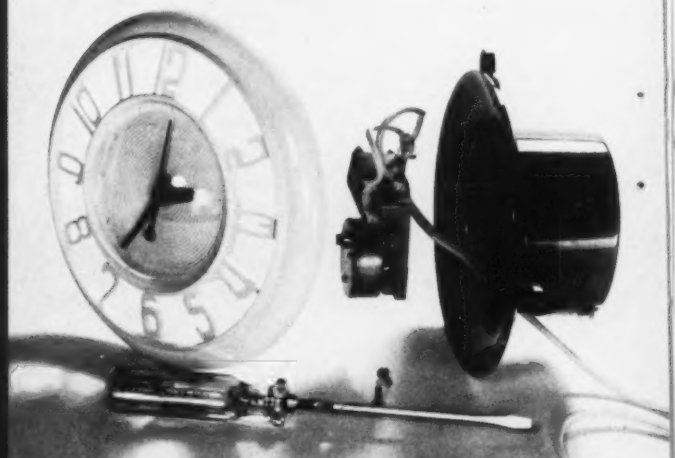
BAKELITE Phenolic Plastics are available in several types. Most applications are served by the new *general-purpose* material BMG 5000. Other types, for specialized uses, include *heat-resistant, low-loss electrical* and *chemical-resistant* grades.

Whatever your needs, check BAKELITE Phenolic Plastics first. For helpful descriptive literature, write Dept. YC-13.

BAKELITE STYRENE PLASTICS



Parts for Telechron Electric Kitchen Clock molded of BAKELITE C-11 Plastics by **Telechron Department of General Electric Company,** Ashland, Mass.

Parts molded of BAKELITE C-11 Plastic serve as both decorative and structural members of this electric clock. The motor is fastened directly to one molded piece which acts as motor mounting, dial and ornamental face. Another molding covers the clock back and forms the shadow box for the numerals.

Big savings in assembly time result because self-tapping screws can be driven into lugs molded in these plastic parts.

BAKELITE C-11 Plastic is an acrylonitrile-styrene copolymer, available in a wide range of colors. It's tough, easily molded and resistant to oils, food, chemicals, moisture and grime.

For information on BAKELITE C-11 Plastics, write Dept. YC-13.

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30 East 42nd Street, New York 17, N.Y.

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BAKELITE Polyethylene can be molded on standard equipment into tiny washers or big 13-gallon carboys. It resists cracking, abrasion, aging. Lightest of all commercial plastics, it promotes important weight savings. It has high dielectric strength and stays flexible down to —70 degrees F. You can get it in virtually any color and mold it into a variety of surface textures.

For a free booklet describing BAKELITE Polyethylene, write Dept. YC-13.

BAKELITE
POLYETHYLENE
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It'll pay you to learn more about BAKELITE Vinyl Elastomeric Plastics. For complete information, write to Dept. YC-13.

BAKELITE
VINYL
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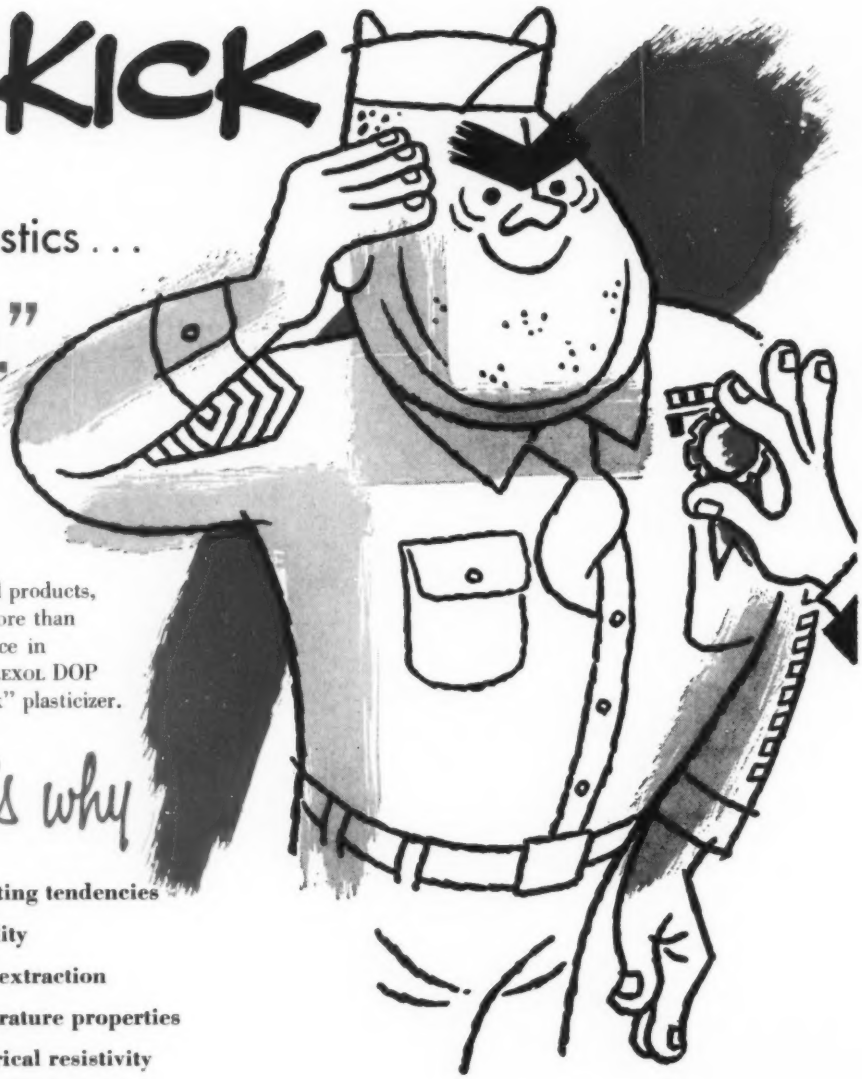

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FIG. 29

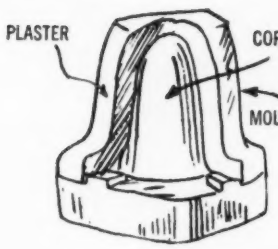


FIG. 30

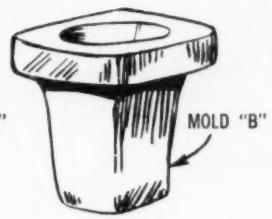
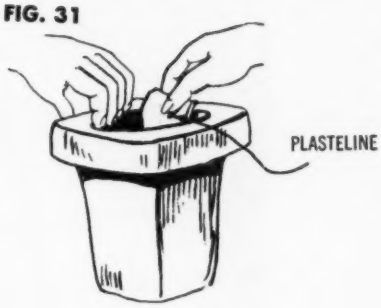


FIG. 31



in 10 or 15 min. and has a tendency to trap air in the mold. Fill the mold until resin overflows in the vents.

If it is necessary to accelerate the curing cycle, allow the resin to complete its initial gelation period and then place the mold in a moderate oven (100 to 150° F.) for an hour. Allow the mold to cool thoroughly before removing the cast; otherwise the elastomer mold is apt to tear in the process of removing it from the cast.

When an elastomer mold is used, no parting agent is necessary except on the shoulder of the case where it is advisable to brush on a generous coat of paste wax. If a plaster mold is used, the instructions given by the manufacturer of the resin should be followed.

The cast will be very resistant to wear and heat without distortion. Being an inert material, the impact strength of any cast phenolic, however, is low.

Keep the resin stored in a domestic refrigerator at 40° F. when not in use.

Epoxy. If a cast possessing high impact strength is desired, an epoxy type material has proved very satisfactory. Epoxy or ethyoxyline products are thermosetting and, in the uncured state, are basically an aliphatic-aromatic chain with reactive ethylene oxide groups at the ends. The conversion of the basic resin is accomplished by means of hardeners such as metals, anhydrides, and compounds with an active hydrogen content. Since virtually no volatile substances are split off, the shrinkage which does occur is very small.

The instructions given by the manufacturer must be adhered to very closely. Too much hardener will produce a quick initial cure but will inhibit the final curing.

Care must also be exercised when mixing epoxies (Coil Seal casting resins are examples) not to contaminate it with any hardener which has been exposed to the air for any length of time, such as on a spoon or mixing paddle or in a container. Clean all implements thoroughly with alcohol after using them, including the spout of the can which contains the hardener. Use disposable drinking cups for mixing containers.

The materials will keep indefinitely at room temperature with the containers tightly sealed.

FIG. 32

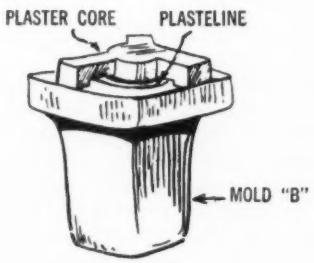


FIG. 33

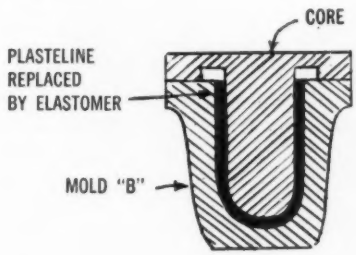


FIG. 34

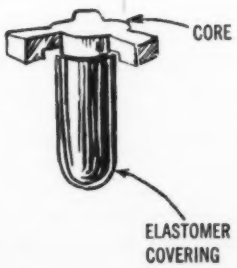
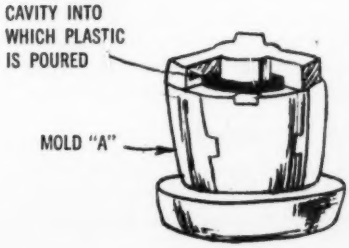


FIG. 35



References:

"Instruction Booklet for ARC 120," American Resin Corp., Chicago, Ill.

"Data Sheet for Coil Seal #11 and #17," National Engineering Products Inc., Washington, D. C.

"Technical Bulletin #71," Elastomer Chemical Corp., Newark, N. J.

"Metal Casting of Sculpture" and "Casting and Molding," by Carl Dame Clark, Ph. D., Standard Arts Press, Butler, Maryland.

CREDITS: Materials referred to in the foregoing article are supplied by the following:

U.S.G. Superfine Casting Plaster and U.S.G. A-11 Hydrocal: United States Gypsum Co., Chicago, Ill.

Kindt-Collins Pattern Cement: The Kindt-Collins Co., Cleveland, Ohio.

Elastomer #17 mold material and Elastomer #22 parting agent: Elastomer Chemical Corp., Newark, N. J.

Coil Seal #11 casting resin, Coil Seal #17 casting resin, and Hardener #1: National Engineering Products, Inc., Washington, D. C.

ARC 120 Resin, #1033 Accelerator, #1033 A Accelerator, acid-washed asbestos, and ground cork: American Resin Corp., Chicago, Ill.

AA mosquito netting: H. Behlen Bros., New York, N. Y.

Photos courtesy Bassons Industries Corp.

Though lighted from below, plastic ceiling appears as a flat skylight illuminated by diffused daylight from above

Lighting System Redesigned in Reinforced Plastics

by Sidney D. Yarm† and George L. Hinds‡

Use of reinforced plastics in fabricating major components of lighting system effects savings in tooling and installation costs

IN THE first commercial application of an unusual new architectural lighting system—developed by Laurence S. Harrison, consulting engineer for the New York Metropolitan Museum of Art, and used experimentally by the museum for several years—reinforced plastics have replaced aluminum in the fabrication of the coffers and mullion frames—two of the major components of the system.

Prior to the adoption of reinforced plastics, the coffers were designed to be drawn from sheet aluminum. Because of wrinkles in the corners and dents frequently encountered while the metal parts were in transit, these coffers needed reworking before installation.

The mullion frames, which also were originally metal, were extremely costly to fabricate. Each mullion frame consisted of four extruded aluminum lengths and four corners cut from a bell-shaped spinning of aluminum. These corners had to be individually hand fitted to the extruded lengths and all sections heli-arc-welded together at eight points. A specially built fixture held the parts securely in position during the welding operation. All welded joints then had to be sanded and blended to the contours of the mullion frame, after which the frame was vigorously polished to eliminate sanding marks.

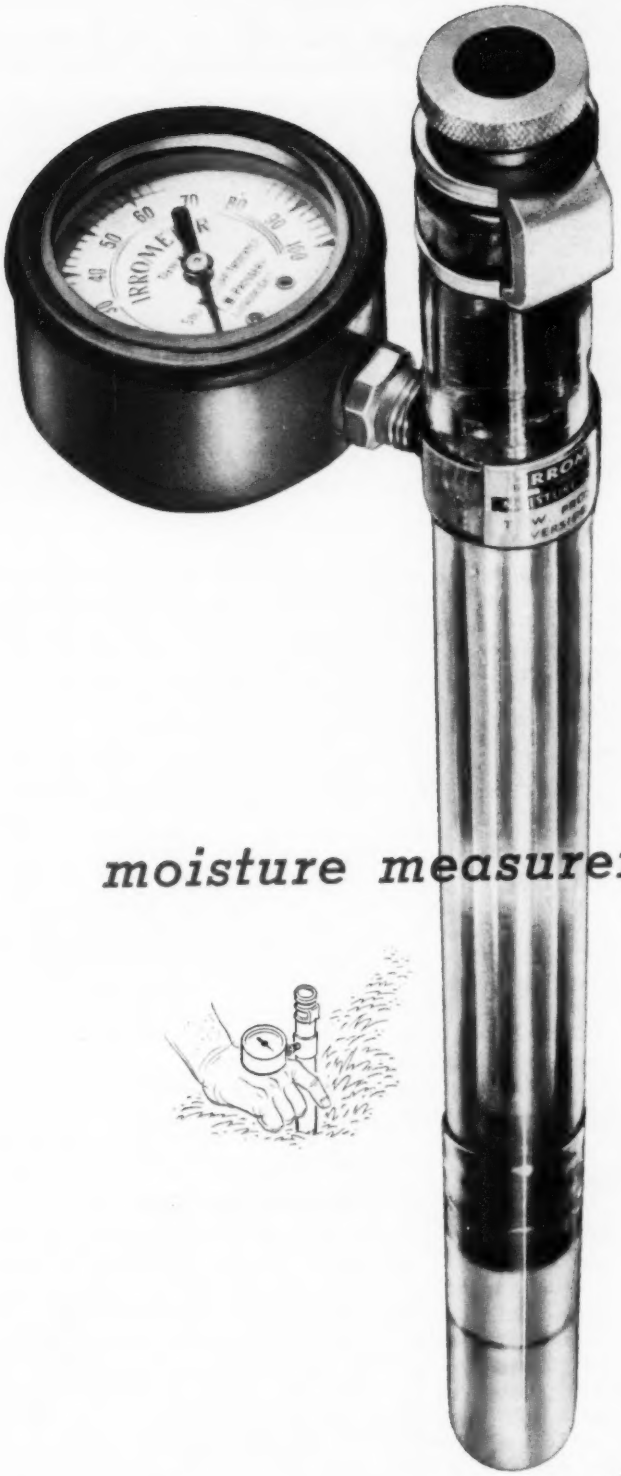
More Economical

As a solution to the problems raised by the use of metal fixtures, Custom Industries, Inc., Hempstead, N. Y., engineers and fabricators of the various components which go to make up the coffer ceilings, suggested the possibility of replacing aluminum with reinforced plastics. After consultation with the molder and with Albin Gustafson Co., New York, N. Y., electrical contractors, it was decided that the switch would not only facilitate handling and installation of the system but would decidedly reduce costs of tooling and production.

As a result, all the coffers and mullion frames in the first commercial installation of the system in the lobby of a recently erected modern office building at 261 Madison Ave., New York, N. Y., are fabricated of reinforced plastics.

The lighting effect produced by the system in this application is

† Assistant Chief Engineer, Bassons Industries Corp.
‡ Vice President, Custom Industries, Inc.



moisture measurer

This instrument is an Irrometer, used to measure soil moisture for irrigation-control purposes. The major portion of the Irrometer—a Tenite Butyrate tube assembly with porous ceramic tip—is placed in the ground to root depth. Dry soil draws fluid from the water-filled instrument through the porous tip, creating a vacuum which is registered on the indicator dial. The reading indicates the moisture content of the soil, so that irrigation water can be supplied when needed.

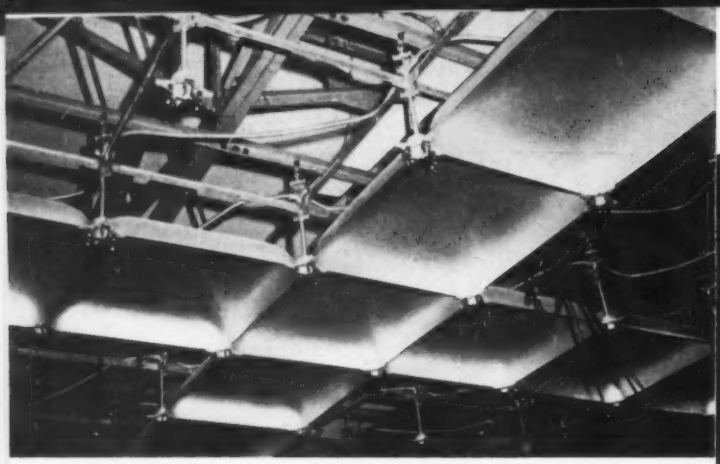
Tenite was chosen for the vital tube assembly because of several advantages: inherent high resistance to breakage, weathering, and soil electrolysis . . . adaptability to solvent welding, assuring joints as tough and leakproof as the plastic itself . . . low heat conductivity, which helps eliminate inaccuracies in readings due to temperature changes.

You'll find tough Tenite used today in many outdoor applications. For an illustrated booklet about the properties and uses of this durable plastic, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

● Information regarding Tenite also can be obtained from local representatives listed under "Plastics—Tenite" in the classified telephone directories of the following cities: Chicago, Cleveland, Dayton, Detroit, Houston, Leominster (Mass.), Los Angeles, New York City, Portland (Ore.), Rochester (N. Y.), St. Louis, San Francisco, Seattle and Toronto — elsewhere throughout the world, from Eastman Kodak Company affiliates and distributors.

● Irrometer with Tenite Butyrate tube assembly manufactured by T. W. Prosser Company, Riverside, California.

TENITE
BUTYRATE
an Eastman plastic



Reinforced plastics coffers are supported only by their corners, must abutt evenly along their lower edges to furnish shadowless illumination

Lighting system has two plastics components—coffer (right) and mullion (left); each part is 45 in. square

agreeably soft and, decoratively, the ceiling appears to be composed of luminous translucent panels set in a framework of mullions. Although the ceiling is actually illuminated from below, it gives the impression of being a flat skylight illuminated from above by perfectly diffused daylight. Because of the evenness with which the coffers are illuminated, the contours of their surfaces cannot be distinguished.

Matched Metal Molds

In molding the coffer and mullion frame, 2-oz. fibrous glass mat impregnated with polyester resins, together with suitable quantities of clay filler and of antimony trioxide and Chlorowax required to assure flameproofness, were used. The mat reinforcement was laid up dry in the female mold half and the resin was then added to the lay-up by the pour-on method.

Matched metal molds were fabricated from aluminum castings, precisely machined and polished to a surface finish of approximately 32 microinches, r.m.s. A single, ribbed casting, which weighed approximately 400 lb. when finished, formed the coffer male mold half. The female was made up of four identical segments, also reinforced by numerous ribs, and had a total weight of approximately 520 lb. as a finished assembly.

The mullion male and female mold halves were each assembled from four straight sides and four radius corner sections, rigidly bolted and pinned together, and weighed 270 and 300 lb., respectively. Each mold half was fastened by numerous bolts and dowels to a ground, parallel-surfaced steel mounting plate, from which it was separated by a rigid, accurately machined transite plate, providing thermal insulation. The mounting added an average of approximately 400 lb. each to the weight of the male and female mold half.

No special means of alignment were provided for the coffer mold, since it was considered that the shape of the mold halves, together with the platen guide system of the press, would be sufficient. Actual operation confirmed the accuracy of this belief. The mullion frame mold was aligned by three heavy guide pins which were set into the female mounting plate and three mating bushings which were fastened to the male mold plate.

Electrically Heated

Both molds were electrically heated. A combination of strip and ring heating units were utilized on the coffer mold and strip heaters alone on the mullion mold. All heating units were connected for 220-v., 3-phase operation. Great care was taken in determining the wattage ratings, placement, and electrical connections of the heaters, in order to assure the most rapid heating possible, consistent with reasonable current consumption, together with uniform temperature distribution and balanced loading on all three legs of the a.-c. line. Power required was 12,000 w. for the coffer male mold half, 15,000 w. for the coffer female, and 9000 w. each for the mullion male and female. Temperature control was maintained by a thermostat mounted on each mold half, which served as a pilot device, actuating an individual 3-phase magnetic contractor for the mold half on which it was mounted.

The molds were operated at a temperature of 230 $\pm$ 10° F., yielding a curing time of 4 minutes. It was found that the most efficient production was obtained when the hydraulic pressure regulators on the molding presses were set so as to produce pressures of 40 p.s.i. on the coffer mold and 70 p.s.i. on the mullion frame mold. These values were based on the projected areas of the respective parts. The greater unit pressure required for the mullion frame was necessitated by its abrupt changes in contour, as compared to the gradual change in curvature of the coffer cross section.

Mounting the Mold

In view of the large size of the parts—outside dimensions of both the coffer and mullion frame are 45¼ in. sq.—means for mounting the mold had to be designed to assure that the molds could be readily installed in the two 150-ton hydraulic presses used for the molding.

In handling the mullion frame female mold mounting, which included a 54-in. sq. steel plate to which the aluminum mold sections were secured, heavy angle blocks were used to transfer the outward loads, acting on the aluminum sections, to the mounting plate. Since the clear width of the available presses was only 50 in., the reinforcing angle

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blocks on two opposite sides of the female mold half were positioned closer to the center of these sides, allowing the corresponding outside corners of the steel mounting plate to be cut away where they would have interfered with the press corner posts.

When the molds were received, the mullion female mold half was installed by the simple procedure of moving it, while tilted to a 45° angle, into the press and then dropping it carefully into a horizonal position with the over-wide portions of the mounting plate just fitting into the space between the pair of columns on each side of the press.

The molded coffer measures 45¼ in. sq. by approximately 13 in. deep and weighs 15 lb. after trimming. The mullion frame is of equal over-all width, but weighs 2½ lb. when finished.

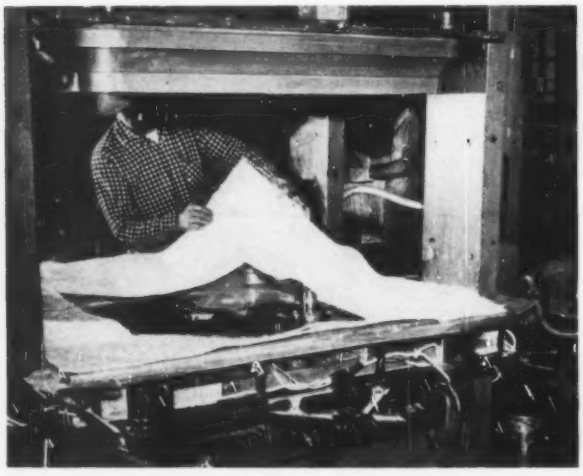
Material thickness for both parts is only 1/16 in., yet they have both successfully withstood, without damage, the same shipping, handling, and installation conditions which had been responsible for costly injuries to the metal parts previously used. Although the plastic coffer could undoubtedly be broken by a sufficiently hard blow, it cannot be dented by any normal impact. Since the specially designed, compound-curved contour of the coffer is essential to produce the desired lighting effect, the inherent resilience of the reinforced plastic part eliminates the necessity for a considerable amount of body-and-fender work which had been required to remove accidental dents from the aluminum parts that had been originally used.

Cooling Jigs

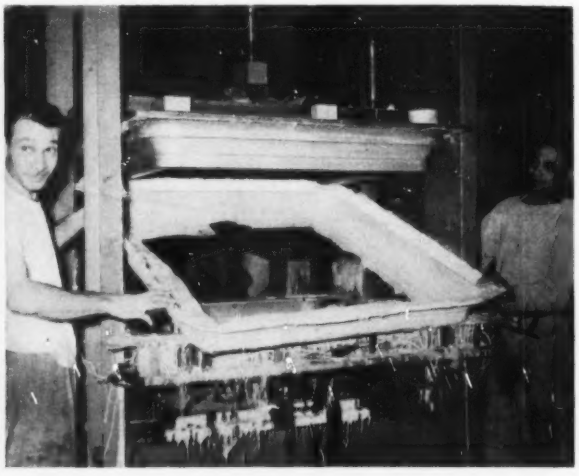
The large size of the parts resulted, as had been anticipated, in considerable shrinkage and corresponding distortion. This condition, if not corrected, would have seriously affected the use of the reinforced plastics parts. In the case of the coffers, adjacent units, supported only by their corners, abutt along the straight portions of their lower edges (see illustration, p. 106). This area of contact must form a straight line, with no space between the touching edges of neighboring coffers. Since illumination of the completed ceiling installation is by means of fluorescent tubes centered beneath the mating edges of adjacent coffers—in effect "edge lighting" the coffers—any deviation of the coffer sides from a true straight line, such as would be caused by the usual inward bowing of the sides resulting from shrinkage distortion, would throw exaggerated shadows up into the concave contour of the coffer. The desired effect of a translucent flat surface, evenly illuminated by a light source located in back of it, would therefore be completely destroyed.

Distortion was overcome by making up a number of oversized male cooling jigs. The part, while still hot from the mold was placed over the jig and allowed to cool to room temperature. The jig was so constructed as to make the over-all size of the coffer, as measured between the midpoints of opposite sides, 46¾ in. when positioned on the jig, as against the desired value of 45¼ inches. To assure dimensional stability, each coffer, after trimming, was again placed on the same jig and postcured in an oven at 275° F. for 30 minutes. The bowed sides of the finished part, when cooled and removed from the jig snapped back from their 46¾-in. dimension, to 45½ in., thus retaining a ⅛-in. outward bow in each side. This assured that when the mating edges of two adjoining coffers are positioned against each other, the resulting light contact pressure would cause both edges to fall into the same straight line.

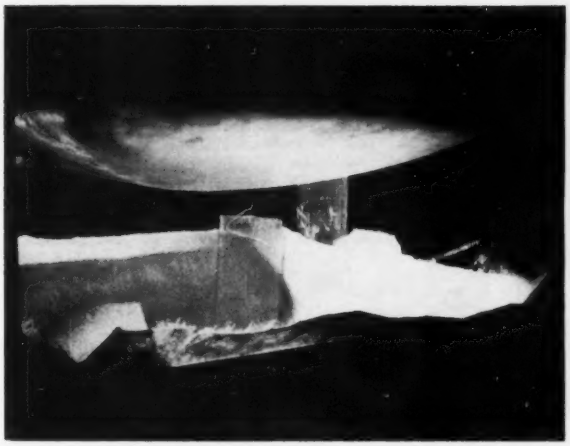
The coffers, in the completed installation, are positioned by their own weight and cannot be fastened down in any manner, since it is essential to the over-all design that each coffer be readily removable for access to the fluorescent lamp ballasts mounted above them. A coffer should thus be capable of removal by raising it off the stirrups which support its four corners and tilting it so as to pass diagonally through the opening of the mullion frame mounted beneath it. This requirement prevented any attempt to overcome the distortion problem by fastening together adjacent coffers by means of rivets, bolts, or clips, even if it would have been possible to



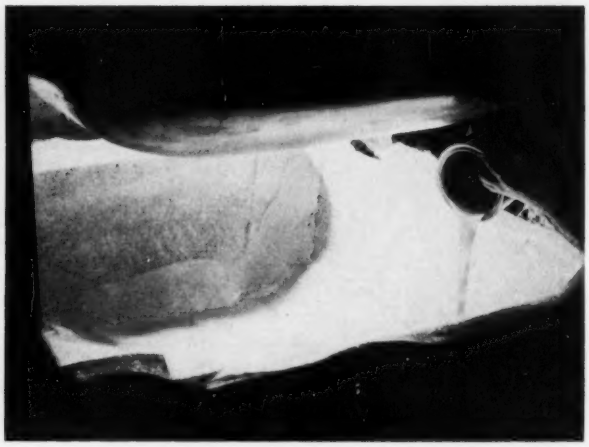
Tailored section of fibrous glass mat is laid on lower half of matched metal mullion mold. The mold is electrically heated



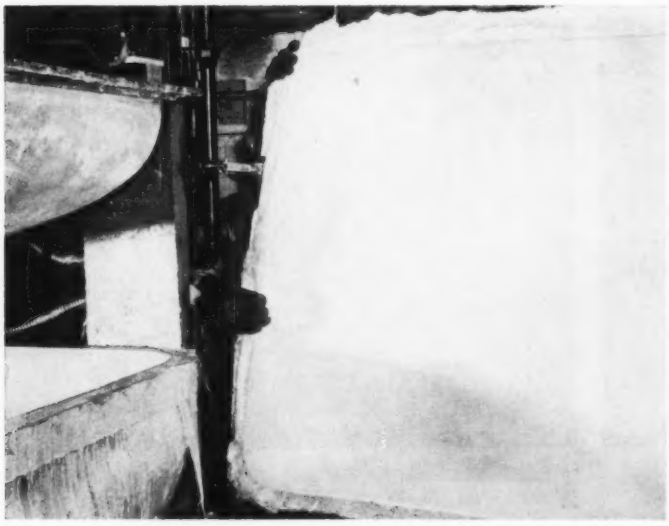
After cure is completed, mold is opened and the mullion removed. Flash is trimmed off after part has been cooled on shrink fixture



Several layers of fibrous glass mat are laid up in cavity of coffer mold. Additional sections are used to reinforce corners



Weighed amount of catalyzed resin is poured over mold lay-up, will be evenly distributed through glass mat by mold pressure



Completed molding of fibrous glass-reinforced plastics coffer is removed from press

find a fastener which would not throw an undesirable shadow up onto the coffer surface.

Distortion of the mullion frame was avoided by a similar jig-cooling and postcuring procedure. The mullion is considerably less of a problem in this respect than the coffer, since the mating lower edges of adjacent mullions rest in and are held together by an extruded aluminum channel.

Finishing of Parts

Prior to shipment, each coffer and mullion frame was thoroughly washed to remove any traces of mold release compound that might interfere with application of the specially formulated matte white casein paint used on the finished ceiling.

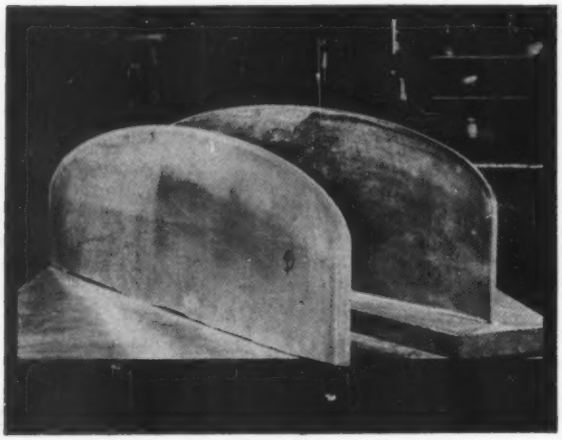
In the installation of the ceiling a problem was raised by the necessity for positioning a coffer and mullion frame around each of two marble-faced columns running through the ceiling. To permit this, a portion of both coffers had to be cut away and one side of both mullions cut through, so that each could be slipped around its column, and the cut edges then rejoined. As a solution, four carefully weighed 1-lb. batches of epoxy resin, together with four correspondingly proportioned amounts of hardener and a quantity of 3 in. wide type 1000 glass cloth, were furnished to the electrical contractor. For the benefit of the electricians who had no experience in handling resins or reinforcing materials, these materials were accompanied by explicit instructions for mixing and applying the resin to produce a wet lay-up type of patch to be applied to the upper, hidden side of the coffers and mullion frames being joined. The ratio of hardener to resin was selected to yield a working time of approximately 45 minutes. No difficulty was experienced by the electrical contractors in obtaining the desired strong, neat joints, despite lack of previous familiarity with reinforced plastics.

The new lighting system is particularly suited to exhibition galleries and public spaces, such as bank floors, showrooms, and entrance halls and lobbies, where ceiling height is above average. From the standpoint of ease of handling and installation, resistance to damage and corrosion, and economy in both tooling and part costs, the reinforced plastics parts serving as the two major components of the system have proved far superior to the metal fixtures previously used.

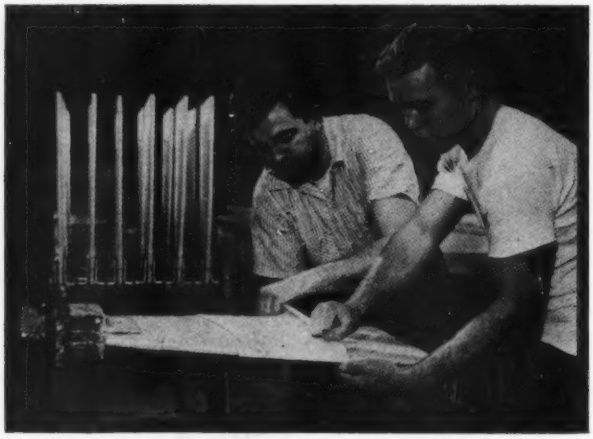
CREDITS: Coffers and mullion frames molded by Bassons Industries Corp., New York, N. Y., using melamine-bonded Uniformat supplied by Ferro Corp., and BRSQ-193 and BRSQ-136 polyester resins supplied by Bakelite Co. Metal molds produced by Long Island Machine and Pattern Works, Brooklyn, N. Y. Araldite 503 epoxy resins and 951 hardener for installation of coffer and mullion frames supplied by Ciba Co., Inc., New York, N. Y.

Matched phenolic dies for metal forming of aircraft parts, cast from Marblette resin #78, accurately conform to the original blueprint details.

Large metal parts like this aluminum gas tank are hydroformed on dies of dimensionally stable resin #78.



Lay-up molds of resin #78 are utilized to produce polyester-impregnated fibrecloth wing tips by the bag molding process.



Pattern duplicates for mass-production latex dipping are made from phenolic resin #71 to slim down girdle manufacturing costs.

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PLASTICS*
TECHNICAL SECTION: Dr. Gordon M. Kline, Technical Editor

Funginertness of Internally Plasticized Polymers

by William H. Stahl† and Helmut Pessen†

IT IS well known that many plastics materials containing plasticizers are readily attacked by fungi and bacteria (1-3).[1] While the plastic as a whole is not consumed, deterioration, as evidenced by such an undesirable change in physical properties as embrittlement, is brought about by the partial disappearance of one essential ingredient, the plasticizer. The following discussion, although applicable in principle to bacteria as well, will be confined to fungi or molds as perhaps the most important organisms that are involved in the degradation of plasticizers.

Fungicides

Protection against this deterioration has been sought in different ways. One obvious approach has been the incorporation of fungicides in the plastics formulation (4, 5a-5c). Although this approach has been successful with certain plastics and for certain applications, it is not a general solution of the problem. Among the factors complicating selection of a suitable toxic agent are requirements of absence of discoloration, odor, toxicity to humans, and detrimental interactions with any of the ingredients of the plastic composition. Furthermore, many of the otherwise most powerful toxicants are ineffective when incorporated in a plastic; even when effective, they must be present in much larger, and therefore costlier, concentrations than in other customary applications. In addition, the very mode of action of these agents tends to make them impermanent since it may require a certain degree of water-solubility and consequently make them somewhat susceptible to undesirable leaching action.

It would seem desirable to obtain resistance to microbial attack not by virtue of some added and possibly fugitive substance such as a fungicide, but on the strength of some "built-in" feature that would assure permanent inability to furnish any nutriment to fungi. The desired property, termed funginertness, must depend on the properties of the polymer and the plasticizer themselves.

When a plasticizer is part of a commercial plastic, the problem is reduced to a systematic search for those chemical and structural features that make a plasticizer usable while being unable to serve as a source for the carbon without which organisms cannot grow. Work in this direction has been carried out already and is still continuing at this date (6).

Internal Plasticization

There are, on the other hand, a number of so-called "internally" plasticized materials in which no plasticizer is employed. Internal plasticization consists in the possession by the polymer macromolecules of structural features that duplicate the effect commonly achieved by external plasticizers, namely the reduction of inter- and intra-molecular forces and the consequent increase in mobility of molecules and portions of molecules. Since thermoplastic resins not containing plasticizers are generally resistant to microorganisms (1-3) with the partial exception of cellulose nitrate and polyvinyl acetate, it might be anticipated that internally plasticized polymers should be likewise resistant. The problem of funginertness in thermoplastics would then be solved whenever an internally plasticized material in all other respects meets the requirements for a particular application. Some previous work in these and other laboratories with a limited number of such materials indicated that they were indeed funginert. The present work reports tests of the resistance to fungal attack of a comprehensive group of currently available plastics that can be considered as having been internally plasticized.

The materials, methods, and results of these tests, and of tests done elsewhere, are compiled in Table I, which appears on p. 112.

Shake-Flask Incubation

The method of test used here was shake-flask incubation, a procedure for routine screening of materials with respect to microbial attack (5a, 5d, 8). Inoculation with spore suspension of the fungus *Aspergillus versicolor* was followed by 7-day incubation on a shaker at 30° C. Those of the materials that were fibers were tested both with and without prior solvent extraction in order to eliminate the possible effect of yarn finishes or other processing aids that might have been applied to them. (Acrilan, X-51, and Tygon were extracted with acetone; Dynel and Vinyon, which swell or dissolve

* Reg. U.S. Pat. Off.
† Pioneering Research Laboratories, U. S. Army Quartermaster Corps.
[1] Numbers in parentheses link to references at end of article.

in acetone, were extracted with ethyl ether). The results, however, were the same, whether there had been extraction or not. For the purpose of comparison, results of tests by other methods, where available, are included in the table. The method of soil burial (1, 3, 4, 5c, 5e), involving prolonged exposure to a variety of fungi commonly found in soil, is applicable only to filamentous or woven or sheet-like materials, since loss in breaking strength or decrease in flexibility is the index of microbial attack. Agar plate (4, 5b, 5e, 5f) and tropical chamber incubation methods (2, 3) may be used where the amount of growth on the substance is to be used as the criterion.

Conclusions

The tabulated data make it apparent that internally plasticized polymers resist degradation by molds. This observation must be qualified since it is based on the behavior of some of the test materials toward only one species of organism. This species, however, has previously been found to be a typical representative of plasticizer-destroyers and to grow with ease on many externally plasticized polymers (6). For research purposes the use of a pure culture is indicated, because with mixed cultures no high degree of reproducibility can be expected and any examination of breakdown products or investigation of mechanism becomes almost meaningless. For practical purposes the use of a mixed culture at times has the advantage of providing a stricter test, possibly because of synergistic action of the enzymes elaborated by the different organisms. The results of the soil-burial tests on Acrilan and X-51 must be viewed in this light.

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Table I—Funginertness of Internally Plasticized Polymers

Polymer trade name	*Type*	*Composition*	*Test results* a,b,c *Shake flask*	*Soil burial*	*Other methods*
Acrilan	Copolymer	Acrylonitrile, approximately 15% vinyl derivatives	R (F)*	S (C-5g)*	.....
Dacron	Condensation polymer (polyester)	Ethylene glycol, terephthalic acid, methyl terephthalate	.....	R (C-5g)	.....
Dynel (Vinyon N)	Copolymer	60% vinyl chloride, 40% acrylonitrile	R (F)	R (C-3, 5h)	R (C-3[d])
Kel-F	Addition polymer	Monochlorotrifluoroethylene	R (G)	.....	.....
KF-VF_2	Copolymer	50% monochlorotrifluoroethylene, 50% vinylidene fluoride	R (G)	.....	.....
Nylon 66	Condensation polymer (polyamide)	Hexamethylenediamine, adipic acid	.....	R (C-3, 5h)	R (C-3[d], N-1[d])
Orlon	Addition polymer	Acrylonitrile	R (F)	R (F-5e, C-5h)	.....
Polythene	Addition polymer	Ethylene	R (G)	.....	R (N-1[d], 2[e])
Saran 115	Copolymer	85% vinylidene chloride, 15% vinyl chloride	R (P)	R (F-5h)	.....
Teflon	Addition polymer	Tetrafluoroethylene	R (Sh)	.....	.....
Tygon	Copolymer	Vinyl chloride, vinyl acetate	R (G)	.....	.....
Velon	Copolymer	Vinylidene chloride, small amount of vinyl chloride	.....	.....	R (N-7[e])
Vinyon	Copolymer	90% vinyl chloride, 10% vinyl acetate	R (F)	.....	R (N-7[e])
X-51	Copolymer	Acrylonitrile, small amount of methyl methacrylate	R (F)*	S (C-5g)*, R (C-5h)	.....
O-123-184 (ERRL)	Addition polymer	Vinyl stearate	R (G)	.....	.....
O-147-79-4, 5 (ERRL)	Copolymer	55% vinyl stearate, 45% vinyl chloride	R (G)	.....	.....
O-147-53-3 (ERRL)	Copolymer	30% vinyl stearate, 70% vinyl chloride	R (G)	.....	.....

*These samples were of yarns manufactured prior to 1953.
[a]Code for test results:
R = Resistant (soil burial: no significant loss of tensile strength; shake flask: no fungal growth).
S = Susceptible (substantial loss of tensile strength; definite fungal growth).
[b]Numbers in parentheses refer to references listed at end of article.
[c]Letters in parentheses refer to physical form tested:
C = cloth, F = fiber, G = granules, P = powder, Sh = shavings, N = not specified.
[d]Agar plate methods.
[e]Method not specified.

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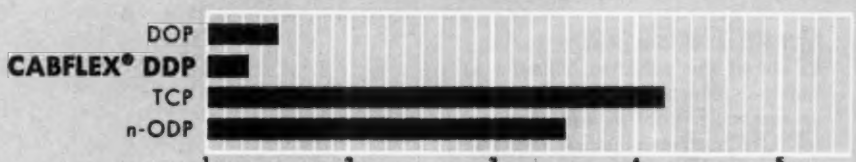

% Weight Loss in Water After 23 Days—Method of E. F. Schulz

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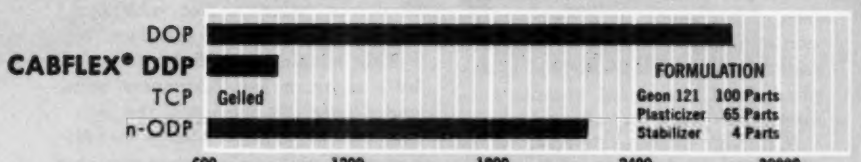

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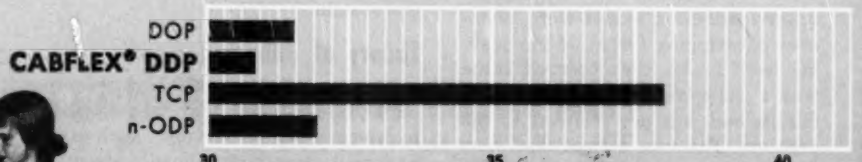

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Adhesion of Polymers to Cellulose

by A. D. McLaren*

A general theory of the adhesion of high polymers to cellulose is presented. The theory includes a consideration of the influence of the following factors: melt viscosity and tack temperature of polymers, kinds and numbers of polar groups in polymers, plasticization, temperature, and nature of the surface. With cellophane-polymer systems polarity and hydrogen bonding are of paramount importance in adhesion.

SINCE 1945 the author has explored the adhesion behavior of high polymers toward cellulose, both as a specific problem and as a tool for help in understanding adhesion phenomena generally (1, 2, 3, 4)[1]. As a tool, cellulose-polymer systems are especially useful. Cellophane has a fairly reproducible, smooth surface of extremely small porosity in non-aqueous systems. Polymers cannot penetrate the surface if applied from the usual organic solvents.

Relative adhesion values were obtained as follows: Cellophane was coated with a polymer from solution and dried. Two pieces of the coated film were heat-sealed together. The films were pulled apart with a Suter tester. The distance of pull, at a nearly constant load for a given specimen, was always the same, namely, 0.75 in. on a specimen 1.5 in. wide. Thus, for polymer coatings the relative minimum loads required to strip the polymers from cellulose were proportional to the work done. Care was taken to see that all such relative adhesion values were measures of stripping forces. If the coating itself broke, the observed value was a cohesive or tensile strength failure and was not relevant to the problem. The rate of pull was slow enough for the stripping force observed to be essentially independent of the rate (5). Results obtained with cellulose were found to be qualitatively like those found with polymer-aluminum foil systems. The results with cellulose-polymer systems also revealed the existence of remarkable differences among polymers.

The process of adhering a polymer to a surface may be looked upon as consisting of the following two steps: The polymer must first adapt itself to the surface, i.e., "wet" the surface. This will occur if the polymer is applied in a solvent or if the polymer is pressed onto the surface. If pressure alone is used, then the pressure must be applied long enough for the wetting action to ensue. The time is shortened by increasing the temperature at a given pressure, by adding a plasticizer, or by introducing copolymer units leading to an increase in polymer fluidity. This first step is a rate phenomenon involving an orientation of dipole, polar, and/or hydrogen-bonding groups at the interface.

This adaptation will be followed by a more or less permanent state and degree of adhesion if the polymer has a cohesive energy density comparable to or less than the energy of adhesion. If the energy of cohesion is high compared with the energy of adhesion, then the observed adhesion will be low (e.g., polythene to cellulose). The second step may thus be looked upon as an equilibrium-adsorption phenomenon. From our experimental point of view the force required in stripping, proportional to the work expended, may be looked upon as a "mechanical titration" of the amount of adsorption, in this sense adhesion, in the system.

Theory of Adhesion

A survey of nearly 100 high polymers has revealed that those with hydrogen-bonding groups, such as hydroxyl or carboxyl, have a strong affinity for cellulose. Those with low hydrogen-bonding facilities, e.g., vinyl esters, or none at all, such as polyethylene, show little or no adhesion to cellulose. Polymers with non-hydrogen-bonding polar groups are intermediate in adhesion property. If we control the rate step by using polymers of constant fluidity, we can study the adsorption step by itself.

The systems of cellulose with ethylene-vinyl alcohol copolymers or vinyl acetate-vinyl chloride-maleic acid (maleic anhydride mostly hydrolyzed) copolymers or mixtures of the latter with vinyl chloride-vinyl acetate copolymer, all have the following feature in common: If the concentration of the hydrogen-bonding group, e.g., carboxyl, is increased in the coating, the force of adhesion increases according to the following characteristic equation:

$$\text{Adhesion} = k\,(COOH)^n \quad \text{Eq. 1}$$

where k and n are constants and $(COOH)$ is the concentration of carboxyl. The exponent n is near the values found for typical adsorption phenomena in solution, namely, 0.5 to 0.7. This probably is more than a coincidence. The adsorption of polymers on charcoal from solution obeys an equation of this type (6). As may

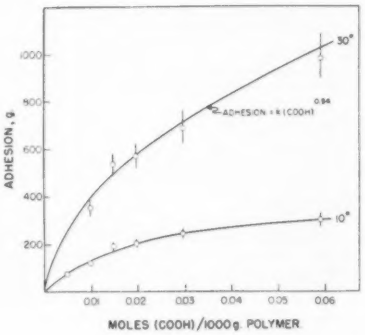
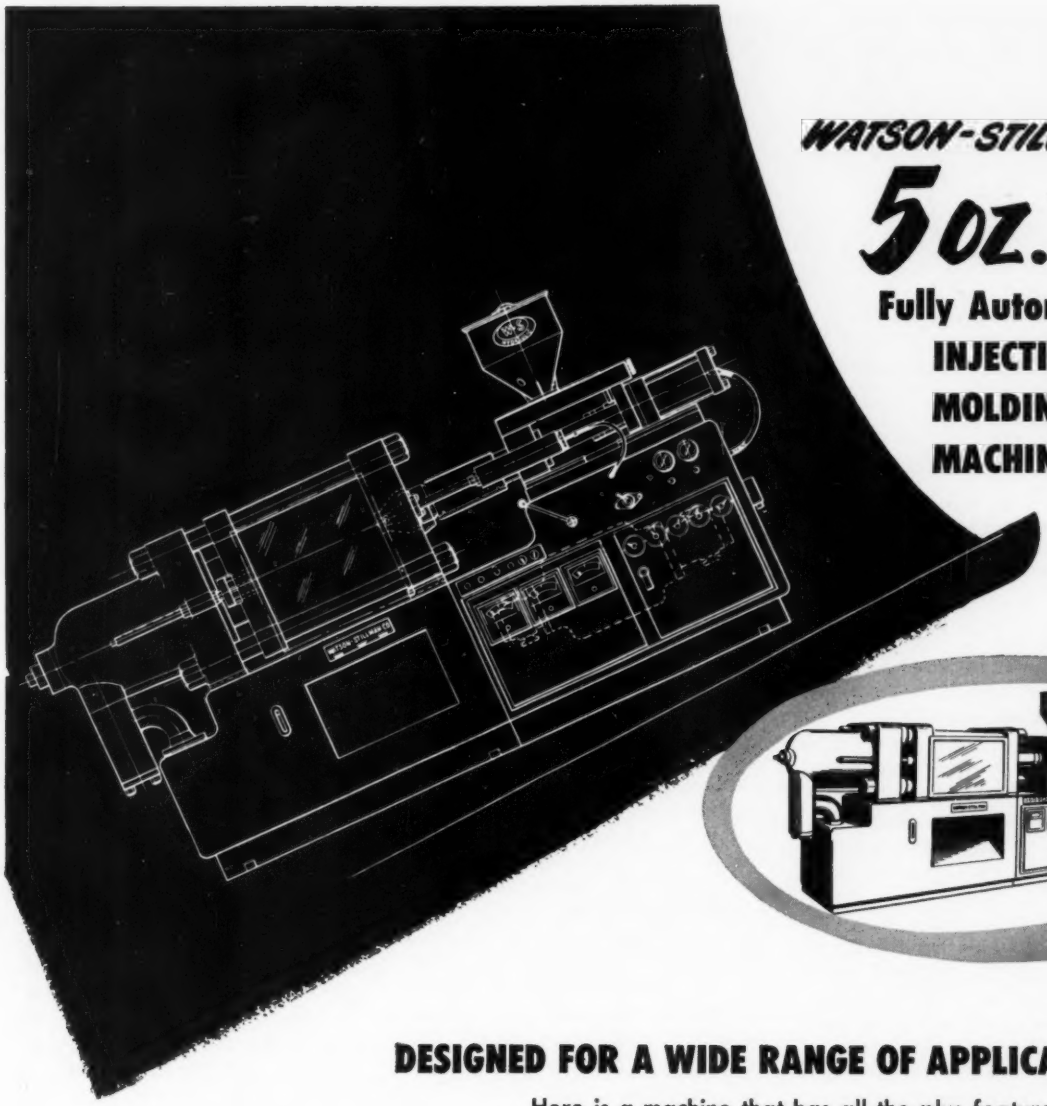


Fig. 1—Adhesion of vinyl copolymers to cellulose as a function of carboxyl concentration at 10 and 30° F. With no carboxyl, adhesion was about 30 g. or less. Points show experimental variation, with 90% of the values falling within ±10% of the average. These variations are typical of results on unmodified cellulose

* College of Agriculture, University of California, Berkeley, Calif.

[1] Numbers in parentheses link to references at end of article.



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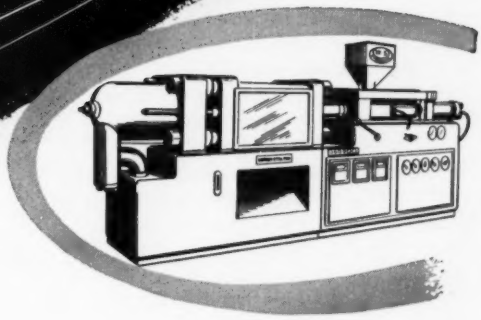

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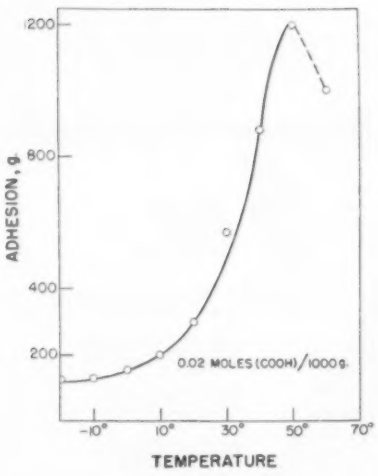

Fig. 2—Adhesion of a vinyl polymer to cellulose as a function of temperature. The broken line at top is indicative of cohesion failure

be seen from Fig. 1, beyond a certain carboxyl concentration, additional carboxyl content will not appreciably increase adhesion.

For such systems, e.g., those mentioned above, ethylene-vinyl chloride copolymers, etc., adhesion shows characteristic temperature-dependent curves (Fig. 2). Beyond the maximum in adhesion the heat seals show cohesion failure in the polymer and the polymer does not strip from the cellulose. With polymers the cohesive energy density is 30,000 to 60,000 cal./mole, which is considerably higher than known heats of adsorption. The combined steps of "evaporation" or diffusion to the interface (requiring more endothermic heat than is gained by the exothermic heat of adsorption) and adsorption at the interface, therefore, give a net heat of the adhesion "reaction" or process, which is endothermic. By Le Chatelier's principle, increasing the temperature gives rise to an increase in adhesion.

Tack Temperature

An inverse measure of the potential adaptability of a polymer to an interface is "tack temperature." Tack temperature is defined as the lowest temperature at which two coated cellophane films will just fuse, i.e., heat-seal at a pressure of 20 p.s.i. applied for 2 seconds. Unlike "tackiness," tack temperature is a precisely defined term for which there is both a theoretical and an experimental foundation (4). The lower the tack temperature, the higher is the fluidity of a polymer. At their tack temperatures, polymers have the same melt viscosities, as must be true for two films to heat-seal during just 2 seconds. Tack temperatures are thus isoviscous temperatures. Polymers with low tack temperatures tend to adhere better to cellulose than those with high tack temperatures, although they may have nearly the same concentrations of identical kinds of polar groups. This influence of variation in fluid properties of the polymers on adhesion is illustrated in Table I.

We can combine these considerations of adaptability (inversely proportional to tack temperature) and adsorbability (related to the dipole moment of polymer polar groups, μ, and the polymer dielectric constant, ε) into a single graph (Fig. 3). Generally, polymers which fall within the area beneath the curve concave to the abscissa tend to adhere to cellophane better than those outside the area.[2] Polyvinyl chloride falls outside the area of adhesion. If a plasticizer is added, however, the polymer-plasticizer properties come within the adhesion area and adhesion is improved. Too much plasticizer carries the system out of the adhesion area again.[3]

If the adhesion of a polymer is measured in the amorphous state, e.g., vinylidene chloride-isobutylene to cellulose, at room temperature, the adhesion may be high, e.g., 700 grams. On crystallizing the adhesion falls, e.g., to 30 grams. The process of crystallization results in a reduction in fluidity. A reduction in fluidity by a two-dimensional crystallization at the second order transition point, as found by Meissner and Merrill (7), also leads to a reduction in adhesion.

[2] Note, however, that polymers with hydroxyl or carboxyl groups tend to adhere to cellophane regardless of where they fall on this plot. Such groups "upset" the adhesion rules just as they upset "solubility" rules. The situation is analogous to the non-solubility of ethyl chloride (μ=1.9) and the solubility of ethyl alcohol (μ=1.8) in water.

[3] Changing one extensive variable, namely, the plasticizer content, can change many other properties, e.g., Σ, of an intensive nature as well.

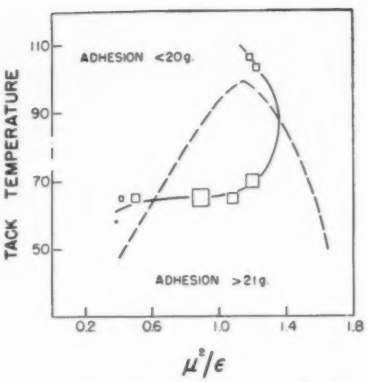

Fig. 3—Adhesion of polymers to cellulose as a function of tack temperature and electrical properties. Adhesion of polymers is greater below curve opening downward. Size of squares indicates relative adhesion of polyvinyl chloride plasticizer system to cellulose. Curve has "S" shape because of dependence of ε on plasticizer content

Effect of Polar Groups

At the beginning we described the adhesion properties of isoviscous polymers as a function of polar group content. As would be expected, series of copolymers that vary in tack temperature as well as in polar group content do not obey equation 1. Such copolymers show greater adhesion, the greater the polar group content, but not according to equation 1 (e.g., styrene-methyl vinyl ketone copolymers). Some show less adhesion (e.g., vinyl chloride-ethylene copolymers, which show maximum adhesion at intermediate chlorine contents, where

(*To page* 181)

Table I—Relation of Fluid Properties to Adhesion of Polymers to Cellophane

Polymer	*Tack Temperature*	*Dipole Moment of Polar Group*	*Adhesion*
	°C.	*Debyes*	*g./1.5 in. of width*
n—Butyl methacrylate	80	1.8	145
n—Propyl methacrylate	90	(R-C-O-R′)	45
Isopropyl methacrylate	105	‖	20
Isobutyl methacrylate	105	O	5
Ethyl methacrylate	110		15
Vinyl chloride–ethylene (82-18)	25	2.0	540
Vinyl chloride–ethylene (82-18)	55	(R-C)	215

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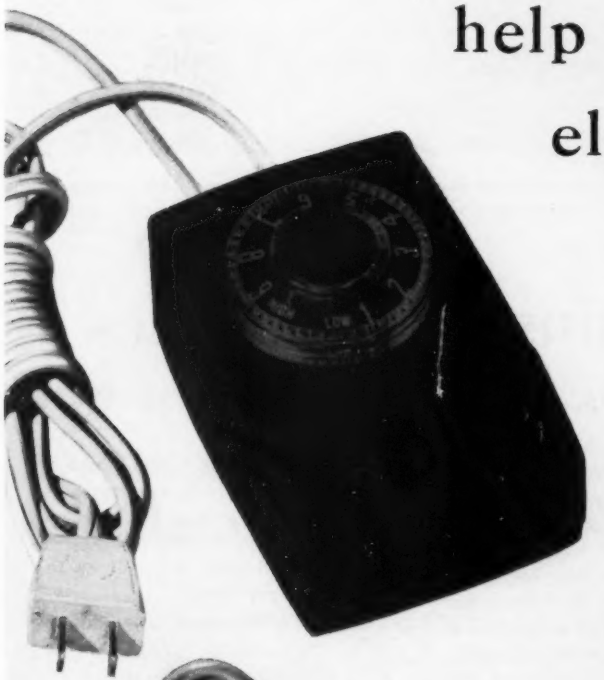

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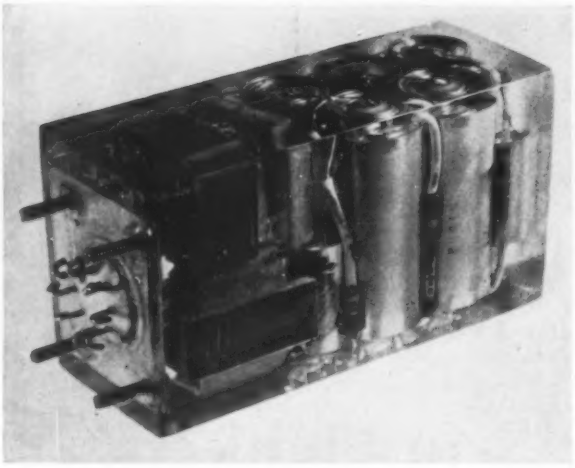
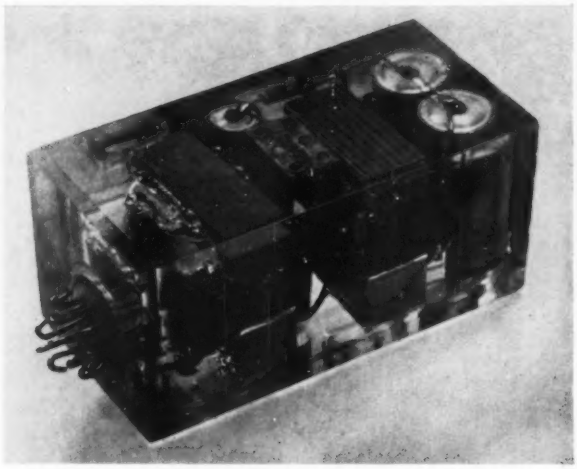




Typical amplifier circuits embedded in epoxy casting resin can withstand moisture, pressure, heat, and long periods of storage under adverse conditions without impairment. Potting of such complete electronic circuits also contributes to greater ease of maintenance

Epoxy Casting Resins in Electronics

by Robert S. Aries*

THE growth of the electronic and the plastics industries during the last two decades has been unmatched by any other industry classification. Research and development in both fields have had a tremendous impact on many other products. The plastics industry has always been essential in electrical work, particularly in insulation and coating. More recently applications have been found for casting resins in the electronic field. A rapidly growing use has been in "potted" circuits, in which electronic components are embedded in a resin. Such encapsulating permits the components to meet exacting requirements, withstand moisture, pressure, heat, and long periods of storage under adverse conditions. This paper will deal with the techniques of encapsulating and the use of some resins of the epoxy type which have been specially prepared for this particular purpose.

There is a major difference between the old methods of potting electronic units in asphaltic materials and the new cast-resin embedding techniques. Asphaltic materials, like tars, pitch, etc., have been used for a long time, but they usually required high temperatures for pouring and generally were not suitable to high frequency and high impedance operations because of their poor electrical properties. High polymer resins are now being used to overcome most of these objections. In addition, they present to the electronic engineer and the electrical component manufacturer a wide range of desirable and needed properties. Casting resins, furthermore, eliminate the necessity of encasing the component and insulating material in metal cans; thus, many costly shop operations are no longer necessary. The absence of such cans, mounting strips, terminals, etc., makes for a smaller, more compact, lighter, and cheaper finished unit.

* President, Aries Laboratories, Inc.

Electronic Component Embedment

Applications of casting and encapsulating techniques are rapidly increasing, since these methods offer numerous advantages. Some of these, in addition to electrical insulating qualities, are rugged and shock-resistant construction; hermetic sealing, resistance to water, chemicals, and other contaminants; elimination of mountings; full utilization of plug-in sub-assemblies; and miniaturization.

Although actual encapsulating techniques vary from application to application, a typical step-by-step method for embedding components can be generalized as involving the following operations:

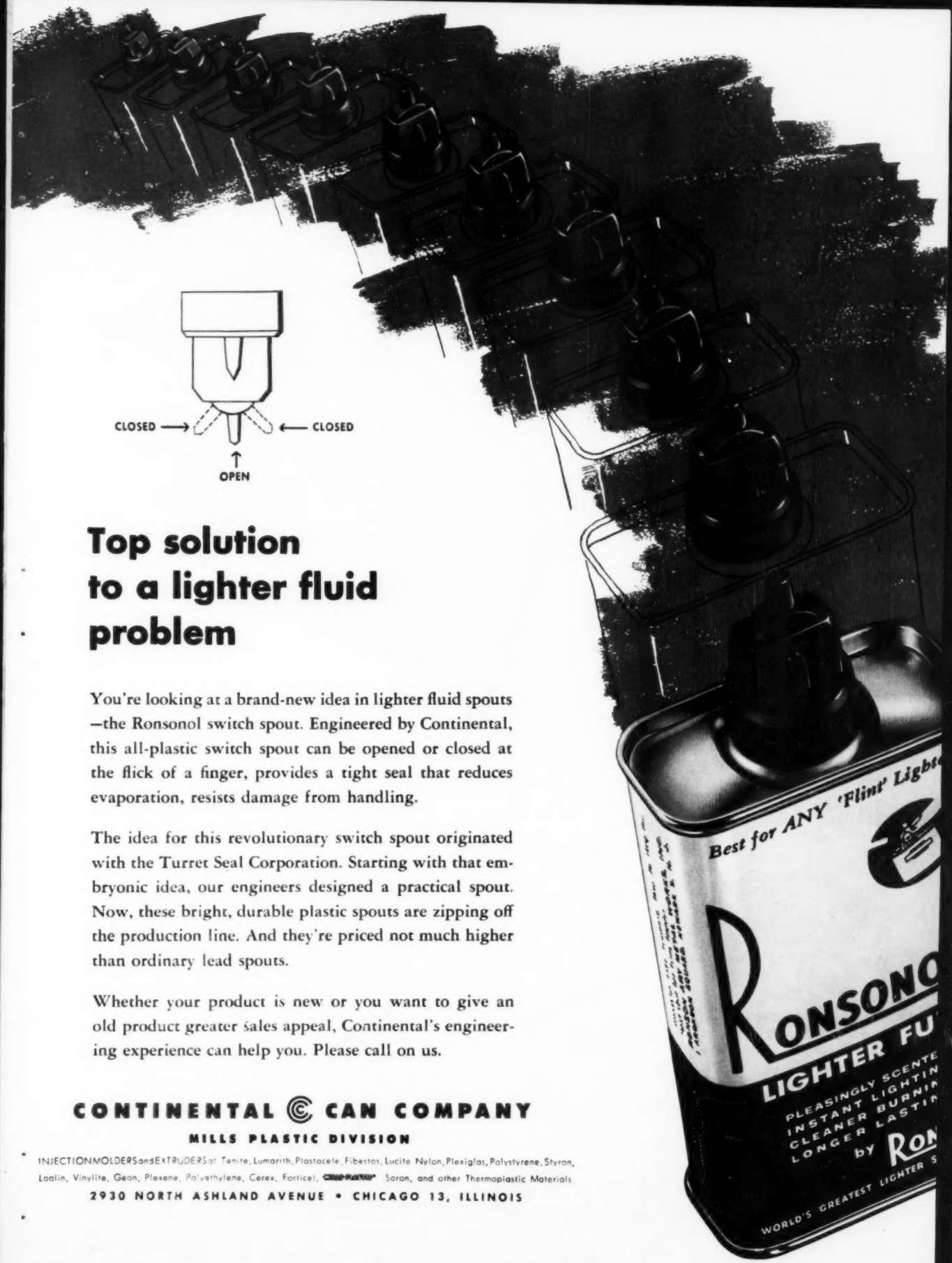
1. A suitable mold (of metal or other material) is designed which will give the desired shape and dimensions to the finished unit. Care should be taken to observe the usual principles of mold design, such as the taper, the breaking of sharp corners, etc.

2. The inside of the mold is coated with a mold-release preparation to facilitate the removal of the embedded component after curing. The specific preparation employed will depend upon the casting resin used. Common mold-release preparations include DC-7, DC-44, silicone grease, Pan Glaze, silicone mold release emulsion, and Airtemp mold release.

3. The component, previously tested for proper performance, is placed in the mold, suitably positioned, and fastened in place.

4. The mold with the component is preheated in an oven to drive off any absorbed moisture.

5. Immediately after removal from the oven, the prepared resin is poured into the mold, either un-



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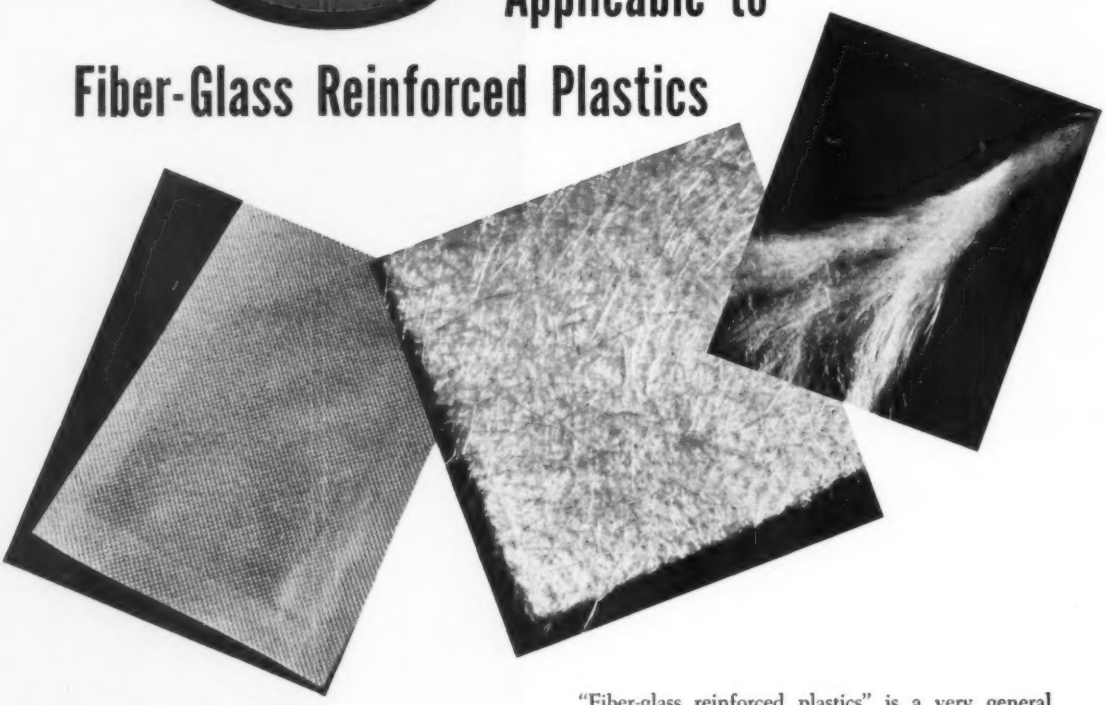

"Fiber-glass reinforced plastics" is a very general term, applied to a broad range of materials with the most diverse properties... and therefore suited to the most amazing variety of applications.

To begin with, fiber-glass itself is available in many forms... as cloth of various weaves, as loosely woven mat, or as rovings. These materials can, in turn, be impregnated with many formulations of the phenolic, the melamine or polyester resins.

Production techniques also vary widely. Short production runs can be economically produced by means of temporary molds. For large quantities matched metal molds can be employed with either high pressure or low pressure molding. Complex shapes can be molded in two or more pieces to reduce tooling costs. The separately molded pieces are then joined with an adhesive which makes the joint as strong as the molded material itself.

All of these various possibilities come within the scope of **MPc** facilities. Look to **MPc** for help with your advance thinking on fiber-glass reinforced plastics. **MPc** will assist you in developing specifications and making the necessary engineering calculations. Extensive laboratory facilities are yours to use in making all tests required for your product. Address your inquiry to MOLDED PRODUCTS, 4535 W. Harrison St., Chicago 24, Ill.

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der atmospheric conditions or under vacuum, depending on the degree of penetration desired. Generally, the resin is prepared for casting by mixing a specific amount of catalyst with the liquid monomeric base resin. In some cases, a solid resin is liquefied at a higher temperature, the catalyst added, and the mixture poured into the mold while in the liquid state. With some of the resins, the addition of a catalyst is not a necessary operation.

6. The filled mold is cured in an oven at the proper series of temperatures.

The Aritemp resins described in this article are of the epoxy type. While in general they possess the chemical properties of this class of resins, they have been developed specifically for encapsulating and impregnating electronic components. They are single-component, solid systems. All the ingredients in their correct proportions have been incorporated and the user simply melts, pours, and cures. There is no necessity for blending the usual hardeners or catalysts just prior to use. Consequently, savings are effected in that fewer inventory items must be stocked, and errors in blending and formulation, which can result in the damage of components often worth many times the value of the resin, are eliminated.

Low Heat Distortion

One of the important properties of the resins is their low heat distortion (40° C.). Castings made with these resins become somewhat rubbery at elevated temperatures. As a result, the resin can withstand internal stresses and strains that are caused by differences in expansion within the casting. This difference in expansion is attributable not only to the fact that a variety of different materials are embedded, each having its own coefficient of expansion, but also to temperature gradients that are established when one or more of the embedded components generate heat. The rubberiness and flexibility does not result in permanent deformation of the casting. Since the resins are thermosetting rather than thermoplastic, there is no flow of resin and recovery is complete.

Potting applications require a 100% polymerizable mixture. No plasticizers that will flow out under extreme conditions and result in a change in properties over a period of time have been added. Many applications call for the use of filler materials, such as mica, talc, and quartz, in conjunction with potting resins. The use of such inorganic fill materials only adds to the brittleness of the casting, and thus increases the possibility of failures due to cracking.

The potting resins are extremely resistant to both high and low temperatures, have excellent mechanical properties, exhibit a marked adhesion to metals, and have a high resistance to water vapor transmission. They have excellent electrical properties, which make them well suited for applications in the electronic industry. Materials commonly used in transformers, coils and other electronic components, such as Ceroc-T wire, silicone glass-served wire, silicone-impregnated fibrous glass, Teflon, Kel-F, Formex wire, iron, nickel, or bare copper are not in any way adversely affected by the potting resins.

Some of the physical properties of one of the Aritemp resins are given in Table I. It is a single-component system, 100% polymerizing without the addition of a catalyst. It is useable in the manufacture of transformers, coil windings, controls, printed circuit networks, antennas, audio amplifiers, transistors, and other electronic components, and meets Specification MIL-T-27, Grade 1, Classes A and H.

Data are given in Table II comparing the insulating properties of a modified epoxy resin with those of a polyester resin. Insulation resistance values as given in the table were made at the temperature designated and the specimen was then raised to the next test temperature until 135° C. was reached. On cooling the epoxy resin, the insulation resistance returns to the original value, indicating no breakdown or decomposition.

Table I—Properties of Aritemp Epoxy Potting Resin

Property	*A.S.T.M. test method*	*Test value*
Tensile strength	D 651-48	13,000 p.s.i.
Compressive strength	D 695-49T	15,000 p.s.i.
Flexural strength	D 790-49T	21,000 p.s.i.
Modulus of elasticity	D 638-46T	500,000 p.s.i.
Heat distortion temperature	D 648-45T	40° C.
Coefficient of expansion	D 696-44	40×10^{-6} mm/°F.
Elongation		30 to 45%
Impact strength (Izod)		0.95 ft.-lb./in.
Arc resistance	D 495-48T	60 sec. at 450 v. rms.
Dielectric constant (25° C)	D 150-47T	3.4-3.7 at 60 cycles 3.5 at 1000 cycles 3.3-3.4 at 1 megacycle
Dielectric strength		700-800 v./mil
Dissipation factor (25° C)		0.005 at 60 cycles 0.004 at 1000 cycles
Insulation resistance		500,000 megohms

Table II—Comparative Insulation Resistance at High Temperature of Aritemp #201 Epoxy Resin and a Polyester Resin

		Insulation Resistance	
Elapsed Time	*Temp.*	*Aritemp #201*	*Typical Polyester Resin*
hr.	*° C.*	*megohms*	*megohms*
0	25	500,000	100,000
100	100	200,000	5,000
200	125	80,000	3,000
400	135	30,000	4,000
600	135	40,000	Resin breaks
800	135	40,000	down due to
1000	135	50,000	decomposition
1200	135	50,000	

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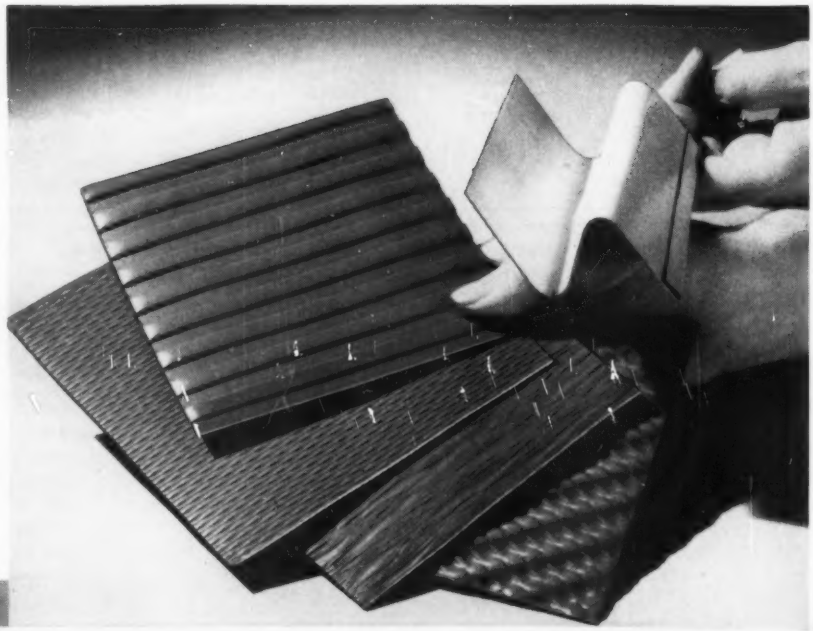

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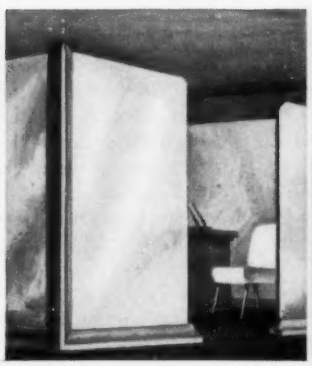

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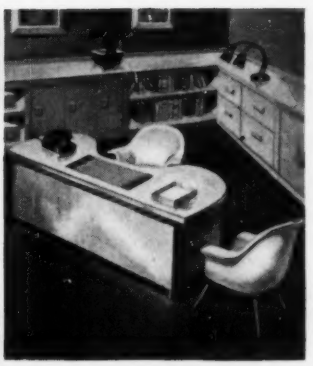

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PLASTICS DIGEST*

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. Send requests for periodicals to the publishers listed.

General

PLASTICS AND THE INDUSTRIAL DESIGNER. J. O. Reinecke. SPE J. *10*, 12-13, 34 (Jan. 1954). Factors involved in the adoption of plastics by industrial designers are discussed. The greatest ally in an industrial designer's work lies in the plastics material field. With the use of plastics, the stylist can construct good sales-winning design at a very low cost per unit by judiciously applying eye-pleasing style and appearance. To make certain that plastics are used, plastics material salesmen, engineers, and custom molders should sell good design on their own.

PLASTICS AS CONSTRUCTION MATERIALS. C. M. Freiherr von Meysenburg. Kunststoffe *43*, 524-29 (Dec. 1953). It is shown that the designer's demand for data cannot refer solely to the characteristics of the material; this applies for plastics as much as for other materials. A design is mainly successful if it is appropriate to the material and to the stresses to which it will be exposed. The experience of the last 50 years in the steel field can be transferred, with due allowances, into the plastics field. A short introduction into the conceptions of shape retention and impact effect is followed by some practical examples.

Materials

RECENT DEVELOPMENTS IN ETHOXYLINE RESINS. J. B. D. MacKenzie. Adhesives and Resins *1*, 179-85 (Sept. 1953). The chemical structure of ethoxyline (epoxy) resins is explained and new forms of "Araldite" that are now available for evaluation are described. Ethoxylines are two-stage resins supplied as liquids or fusible solids and converted by the addition of various hardeners into infusible and insoluble solids of considerable mechanical strength. Chemically they are polyaryl ethers of glycerol, with alternating aromatic and aliphatic groups connected by stable ether linkages. The presence of both hydrocarbon and polar centers in the molecule ensures good wetting of many different kinds of surfaces with resultant excellent adhesion. Volume shrinkage during curing is very low, and there is no evolution of by-products. Since the hardener is chemically combined into the product, different hardeners may be used to modify the properties of the cured resin without the use of plasticizers. An expanded epoxy resin was developed that meets the demand for lightweight structural materials having good dielectric and mechanical properties. Expansion and curing can be done *in situ* by application of heat. The resin is formulated to give a viscosity and gelation rate that permit a stable, uniform foam to develop before the resin sets. A new impregnating resin was developed that has both low viscosity and good pot-life without the use of solvents. It cures on heating without the evolution of vapors to cause blowholes. It is particularly suitable for applications such as the impregnation of porous metal castings, sheet metal laminates, transformer windings, and fabrics for electrical purposes. Another new development is a hot-setting filler designed to replace the body solder normally used in motor cars with a filler that possesses resilience as well as adhesion and hardness. A flexible epoxy casting resin was formulated that can be adjusted to give a range of products varying in elasticity from that of the normal casting resin to soft elastic materials resembling natural rubber, while still retaining their infusibility. A similar material is available as an adhesive of bonding components with widely different coefficients of expansion.

PHENOLIC FOAM. J. D. Nelson. SPE J. *9*, 14-15, 34-35, 37 (Dec. 1953). The preparation, properties, and applications of phenolic foam are described. This material is prepared from liquid phenolic resin without the need for application of external heat or pressure and can be foamed in place. The resulting foam consists of both independent and interconnected air pockets and its properties are naturally closely related with the basic characteristics of the base resin. Phenolic foam is a self-extinguishing material, has excellent resistance to chemicals, and can be used up to temperatures of 300° F. The largest volume used to date has been in foamed-in-place applications in aircraft and ships. It is also being used for thermal insulation and for sound deadening.

STYRENATED ESTERS OF BISPHENOL-EPICHLOROHYDRIN CONDENSATES. R. W. Tess, R. H. Jakob, and R. F. Bradley. Ind. Eng. Chem. *46*, 385-90 (Feb. 1954). Bisphenol-epichlorohydrin condensates are recognized as useful components in the manufacture of various surface coatings. To extend this usefulness an investigation of the film-forming properties of polymerized mixtures of styrene and unsaturated drying oil esters of the condensates was undertaken. A solvent method of styrenation was devised wherein essentially all of the styrene was combined with the esters. The effects of various factors, including temperature and styrene concentration, on the rate and extent of reaction were studied. The styrenated esters dried very rapidly and were superior to styrenated alkyd resins in mar resistance, flexibility, and alkali resistance. Vinyltoluene appeared to be generally similar to styrene in these products.

EBONITE TODAY. B. L. Davies. Plastics (London) *19*, 47-49 (Feb. 1954). The early development of ebonite is discussed and the uses for this material up to the present are presented. Annual production of ebonite in England is still increasing, probably because its combination of properties renders it eminently suitable for certain applications, notably those involving electrical insulation and/or corrosion resistance, coupled with suitable mechanical characteristics. There have been no outstanding improvements in the properties of ebonite, but molding methods have been refined.

A SYMPOSIUM ON VINYL COMPOUNDING. PART II. SPE J. *9*, 21-24

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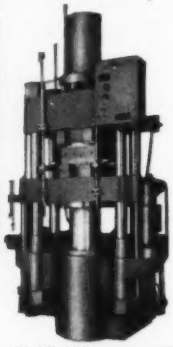

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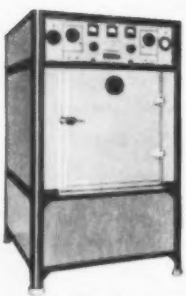

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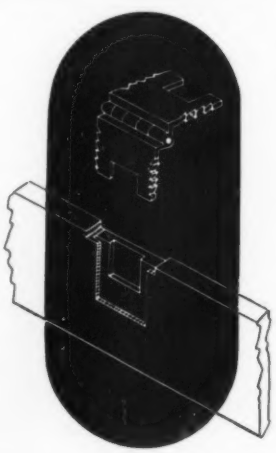

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109 LONG AVENUE

HILLSIDE, N. J., U. S. A.

(Dec. 1953). The calendering of vinyl compounds, vinyl plastisols, and miscellaneous properties of resins are discussed.

POLYVINYL PYRROLIDONE. W. Reppe. Angewandte Chemie *65*, 577-78 (Dec. 1953). A description is given of the production, properties, and applications of polyvinyl pyrrolidone, a blood plasma substitute for cleansing serum and tissue, depot substance for pharmaceuticals, and auxiliary in textile and plastics chemistry.

Molding and Fabricating

VACUUM FORMING OF POLYSTYRENE SHEET. J. M. Hoy. SPE J. *10*, 9-10, 33 (Jan. 1954). The methods of vacuum forming thermoplastic sheet, the equipment required, and the advantages of this process are described. The major advantages of vacuum forming include low tooling cost, comparatively low capital investment, and versatility of equipment to make large or small parts and quantities. Vacuum forming may be accomplished by drawing over a male form or into a female form. By using a male mold, it is possible to achieve more even distribution of material in the lower sections of the formed part. The female mold is more satisfactory for multiple cavity operations and also has the advantage of being generally simpler to use machine-wise. The essentials of a vacuum forming machine are the heat source, vacuum equipment, the clamping frame, and the mold platform. Because low pressures and relatively low temperatures are employed, a wide variety of low-cost, low-strength mold materials may be used. The construction characteristics of vacuum forming equipment make it possible to produce vacuum molded parts in a variety of shapes and sizes with only one piece of equipment.

EXTRUDERS. H. Beck, Kunststoffe *43*, 530-39 (Dec. 1953). The present state of theoretical knowledge of extruders is discussed. Ten conditions are enumerated which are concerned with the use of extruders. General problems are posed and an investigation made as to how near practical designs have come to solving these problems. The performance of an extruder within circumscribed limits can be defined regarding quantity and quality. The formation

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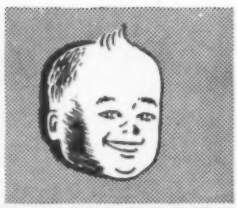

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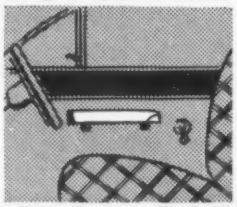

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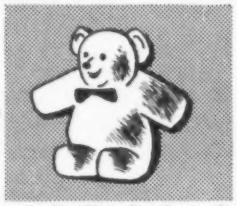

PLASTISOLS

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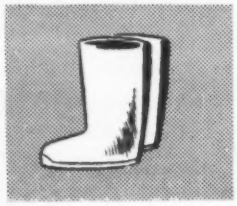

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of a technical committee is recommended to further the development of extruders.

PROCESSING OF POLYAMIDES ON THE EXTRUDER. J. F. Kohlwey. Kunststoffe *44*, 3-5 (Jan. 1954). The characteristic processing properties of polyamides are considered; this is followed by an examination of the functional elements of the extruder with regard to their requirements and working methods. The high shear action of polyamides demands a special hopper design. The worm must be divided into preheating, melting, and pressure zones. What happens in these zones is discussed both from the practical point of view and on the basis of mathematical theory. The heating and design of dies are considered.

PRINTING OF THERMOPLASTICS. W. Kuhn. Kunststoffe *43*, 544-46 (Dec. 1953). A short description of the most important printing processes is followed by a description of the machines which can be used for printing on polystyrene, polyvinyl chloride, and polythene.

Applications

POLYETHYLENE FOR CITRUS. H. W. Hruschka and J. Kaufman. Modern Packaging *27*, 135-138, 184 (Feb. 1954). Tests were initiated to compare mesh bags with perforated and non-perforated polyethylene bags as containers for Florida oranges and grapefruit and to compare unwrapped and polyethylene overwrapped trays for lemons and limes. In general, weight loss was greater in the unwrapped trays or mesh bags than in the film-packaged fruit, giving the latter a slight advantage in keeping quality. Decay varied between tests but in general it was higher in the polyethylene-bagged lots than it was in the check lots. On the basis of these tests, polyethylene was found to be a satisfactory bagging or wrapping material for citrus fruit when sound, vigorous fruit was packed and moved fairly rapidly through the retail channels. Perforation of bags was beneficial.

COMPRESSION - RESISTANT REINFORCED PIPES MADE OF POLYVINYL CHLORIDE, A NEW MATERIAL FOR PIPELINE CONSTRUCTION FOR THE CHEMICAL INDUSTRY. H. Steinmann and H. Saechtling. Chemie-Ingenieur-Technik *25*, 341-43 (June 1953). Pipe made of rigid polyvinyl chloride and metal is described. This product has a high compressive strength and strong connections between sections can be made. Fittings are made in a similar manner.

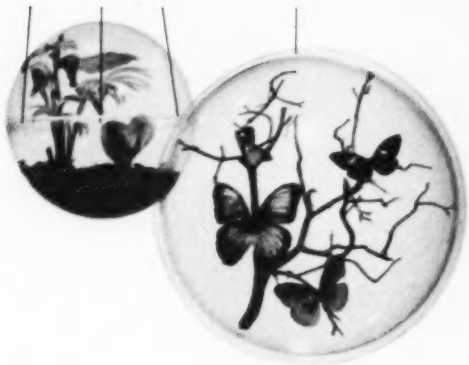
PLASTICS FOR LAMSON TUBES. Plastics (London) *19*, 8-9 (Jan. 1954). The various types of plastics used in pneumatic tube conveyor systems for stores and factories are discussed. These include the use of phenolic laminates, extruded cellulose acetate, wire-reinforced cellulose acetate sheeting, polyethylene, and rigid polyvinyl chloride for the conveyor system carriers.

COLLAPSIBLE VINYL TUBE FOR PACKAGING Brit. Plastics *27*, 52 (Feb. 1954). Flexible polyvinyl chloride is now being used to produce, on a commercial scale, collapsible tubes for packaging fluids and powders. The new tubes are made from a lay-flat polyvinyl chloride extrusion and have no side or shoulder seams, thus avoiding the chief defects of previous plastic tubes, i.e., seepage or bursting at the seams. Since the tube end and shoulder are welded, the fracture or bursting stress of the tube is that of the polyvinyl chloride material itself. No protective cartons are required for the tube when full, as is generally the case when metal tubes are used.

Properties

PRACTICAL INDICES FOR CHEMICAL-RESISTANT PLASTICS. R. B. Seymour. SPE J. *10*, 14-15 (Jan. 1954). A chart is presented in which approximately thirty plastics materials commonly used for chemical-resistant construction and several non-plastic products have been graded on five physical and five chemical properties in an attempt to provide a simple method for comparing the properties of these various materials. A summation of the five values for any specific material for either the physical properties or the chemical properties will supply an index of the over-all resistance.

DIFFUSION OF POLYSTYRENE FRACTIONS IN DICHLOROETHANE. V. N. Tsvetkov and S. I. Klenin. National Science Foundation translation (NSF-tr-27); Doklady Akademii Nauk SSSR *88*, 49 (1953). The dependence of the diffusion coefficient of a polymer on its molecular weight is directly related to the mobility and form of the macromolecules and



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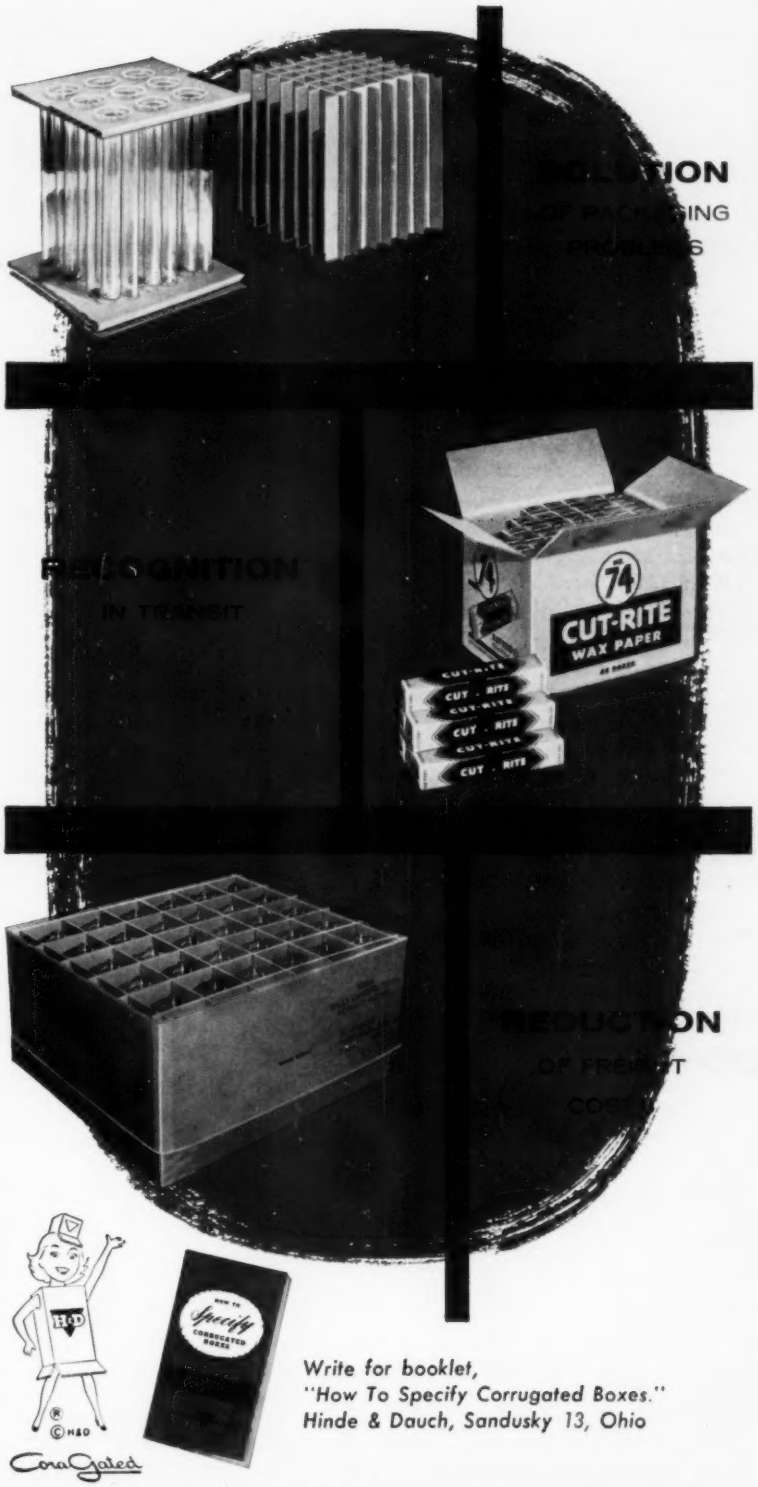
therefore provides useful information concerning the structure of molecular chains. The diffusion behavior of fractions of different molecular weights from a single sample of polystyrene obtained by block polymerization of the monomer at 60°C. is described. The molecular weights of the fractions were calculated from their intrinsic viscosities in highly dilute dichloroethane solutions. The method of polarization-interferometry was used to measure the diffusion coefficients of the fractions in dichloroethane.

ON THE STRETCHING OF POLYMER CHAINS. M. V. Volkenshtein and O. B. Ptitsyn. National Science Foundation translation (NSF-tr-134); Doklady Akademii Nauk SSSR *91*, 1313-16 (1953). A mathematical treatment of the direction and magnitude of the forces involved in the orienting of chain segments during the stretching of polymer chains is presented. The usual theory and equation take into account such factors as the stretching force, the projection in the direction of the force of the vector which joins the ends of the chains, and the number and length of the freely coupled segments. To establish the connection between the mechanical properties of elastomers and their chemical structure, it is necessary to take into account such additional factors as the existence of fixed valence angles and hindrance to internal rotation in the polymer molecules. Using a one-dimensional model of a polymer chain, the authors proceed to develop the mathematical theory which takes these factors into account and suggest that it applies in a general way also to three-dimensional chains.

Testing

A RECORDING VISCOSIMETER FOR FLOW CURVES. E. Helmes. Chemie-Ingenieur-Technik *25*, 390-94 (July 1953). The rheological properties of many substances of importance in chemistry and other industries, such as emulsions, suspensions, plastics materials, thickeners for the printing trade, paints, etc., are very different from those liquids of normal viscosity. These properties are of great importance with regard to the technical application of such products. A device developed for use in the laboratory, which permits a fully automatic recording of the flow curve of a substance, is described.



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U. S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

GEL. D. E. Sargent and J. C. Bailar, Jr. (to General Aniline). U. S. 2,671,022, Mar. 2. Polyvinyl alcohol photosensitive gels.

WEATHER STRIPPING. H. M. Dodge (to General Tire and Rubber). U. S. 2,671,041, Mar. 2. Plastic weather stripping.

ION EXCHANGE. P. Smit (to N. V. Octrooin Maatschappij "Activit"). U. S. 2,671,059, Mar. 2. Meta-phenylene diamine-formaldehyde condensates.

POLYMERS. R. C. Morris, E. C. Shokal, and V. W. Buls (to Shell). U.S. 2,671,060, Mar. 2. Polymers of unsaturated esters of substituted cyclohexane-carboxylic acids.

PLASTIC. O. R. Sweeney, L. K. Arnold, and J. T. Long (to Iowa State College). U. S. 2,671,061, Mar. 2. Furfural-lignin plastic.

WRINKLE FINISH. W. A. Waldie (to New Wrinkle). U. S. 2,671,062-3, Mar. 2. Polyvinyl chloride-acetate-alcohol copolymer wrinkle finish; vinyl resin-alkyd wrinkle finish.

STABILIZER. E. E. Cowell and J. R. Darby (to Monsanto). U. S. 2,671,-064, Mar. 2. Stabilizing halogen resins with cadmium salts and epoxy-resins.

DISPERSION. E. W. Ulrich (to Minnesota Mining). U. S. 2,671,065, Mar. 2. Dispersion of polyvinyl acetate in polyacrylic acid.

SOLUTIONS. J. L. Justice (to Chemstrand). U.S. 2,671,066, Mar. 2. Solutions of polyacrylonitrile containing an inorganic salt of an organic amine.

SOLVENTS. R. L. Brown (to Du Pont). U. S. 2,671,067, Mar. 2. Dimethylene glycolamides as solvents for polyacrylonitrile.

RESINS. R. L. Knapp (to U. S. Rubber). U. S. 2,671,070, Mar. 2. Copolymers of dicyclopentadiene, maleic anhydride, and a glycol.

POLYAMIDES. T. T. M. Laakso and D. D. Reynolds (to Eastman Kodak). U. S. 2,671,071, Mar. 2. Polyamides.

POLYMERS. G. E. Ham and A. B. Craig (to Chemstrand). U. S. 2,671,-072, Mar. 2. Dye-receptive acrylonitrile polymers.

POLYMERS. J. A. Price (to American Cyanamid). U. S. 2,671,076, Mar. 2. Polymerized N-vinyl-N-alkyl guanidine.

POLYMERS. W. B. McCormack (to Du Pont). U. S. 2,671,077-8-9-80, March 2. Phosphorus-containing polymers.

PLASTICS. P. Mosse (to Societe Rhodiaceta). U. S. 2,671,089, Mar. 2. Shaped polyacrylonitrile articles.

ARTIFICIAL LIMB. W. Schoene and D. G. Monroe (to Bardach-Schoene). U. S. 2,671,225, Mar. 9. Plastic socket for artificial limb.

MOLDING. N. Lester (to Lester Engineering). U. S. 2,671,246-7, Mar. 9. Mold overload compensator.

GLASS FIBER MAT. D. W. Klohs (to Sun Chemical). U. S. 2,671,738, Mar. 9. Glass-fiber mat impregnated with rosin-modified phenolic resin.

GLASS FIBERS. L. P. Biefeld and J. P. Stalego (to Owens-Corning). U. S. 2,671,744, Mar. 9. Glass fibers coated with a polyamide.

ACRYLONITRILE. P. Halbig. U. S. 2,-671,768, Mar. 9. Solutions of acrylonitrile polymers in mixtures of aqueous nitric acid and nitromethane.

RESINS. J. K. Simons (to Allied Chemical). U. S. 2,671,771, Mar. 9. Epichlorohydrin-sulfonamide resins.

COPOLYMERS. R. N. MacDonald and R. S. Schreiber (to Du Pont). U. S. 2,671,772, Mar. 9. Alpha-amino acid copolymers.

ESTERS. J. J. Giammaria (to Socony-Vacuum). U.S. 2,671,773, Mar. 9. Esters of thiophene-modified copolymers of maleic anhydride and aliphatic vinyl compounds.

COPOLYMERS. E. A. McCracken and A. L. Chaney (to Standard Oil). U. S. 2,671,774, Mar. 9. Isoolefin multiolefin copolymers.

CELLULOSE ESTERS. M. Plunguian (to Celanese). U. S. 2,671,777-8, Mar. 9. Carboxylic acid esters of cellulose.

POLYMER. K. M. Gaver, E. P. Lasure, and T. V. Tieszen (to Ohio State Univ.). U. S. 2,671,779-80-1, Mar. 9. Substituted glucopyranose polymers.

COATING. H. A. Clark (to Dow Corning). U. S. 2,672,105, Mar. 16. Silane polymer coating for metals.

COATING. R. J. Rother and A. R. McManus (to Gaylord Container). U. S. 2,672,454, Mar. 16. Paperboard coated with butadiene-styrene copolymer.

MOLDING COMPOSITIONS. C. W. Gayler (to American Viscose). U. S. 2,672,456, Mar. 16. Acrylonitrile–vinyl chloride copolymer compositions.

BATTERIES. H. C. Burns and H. D. Wilson (to Electric Auto-Lite). U. S. 2,672,497, Mar. 16. Storage batteries of phenolic resin castings.

SPRAYING. J. B. Brennan. U. S. 2,673,121, Mar. 23. Apparatus for spraying thermoplastic material.

RESIN. H. L. Gerhart (to Pittsburgh Plate Glass). U. S. 2,673,151, Mar. 23. A photosensitive copolymer.

RESIN. K. Dietz (to Farbwerke Hoechst Aktiengesellschaft vormals Meister Lucius und Brüning). U. S. 2,673,190, Mar. 23. Low-temperature-hardening epoxy-type resins.

VINYL RESINS. R. G. Wolf (to B. F. Goodrich). U. S. 2,673,191, Mar. 23. Light-stable vinylidene chloride polymer.

POLYMERIZATION. A. Hill (to Diamond Alkali). U. S. 2,673,192, Mar. 23. Chlorate-sulfite redox-initiated polymerization of vinyl derivatives.

POLYMERIZATION. J. M. Grim (to Koppers). U. S. 2,673,194, Mar. 23. Suspension polymerization.

MOLDING. E. C. Uhlig (to U. S. Rubber). U. S. 2,673,371, Mar. 30. Molding thermoplastic articles.

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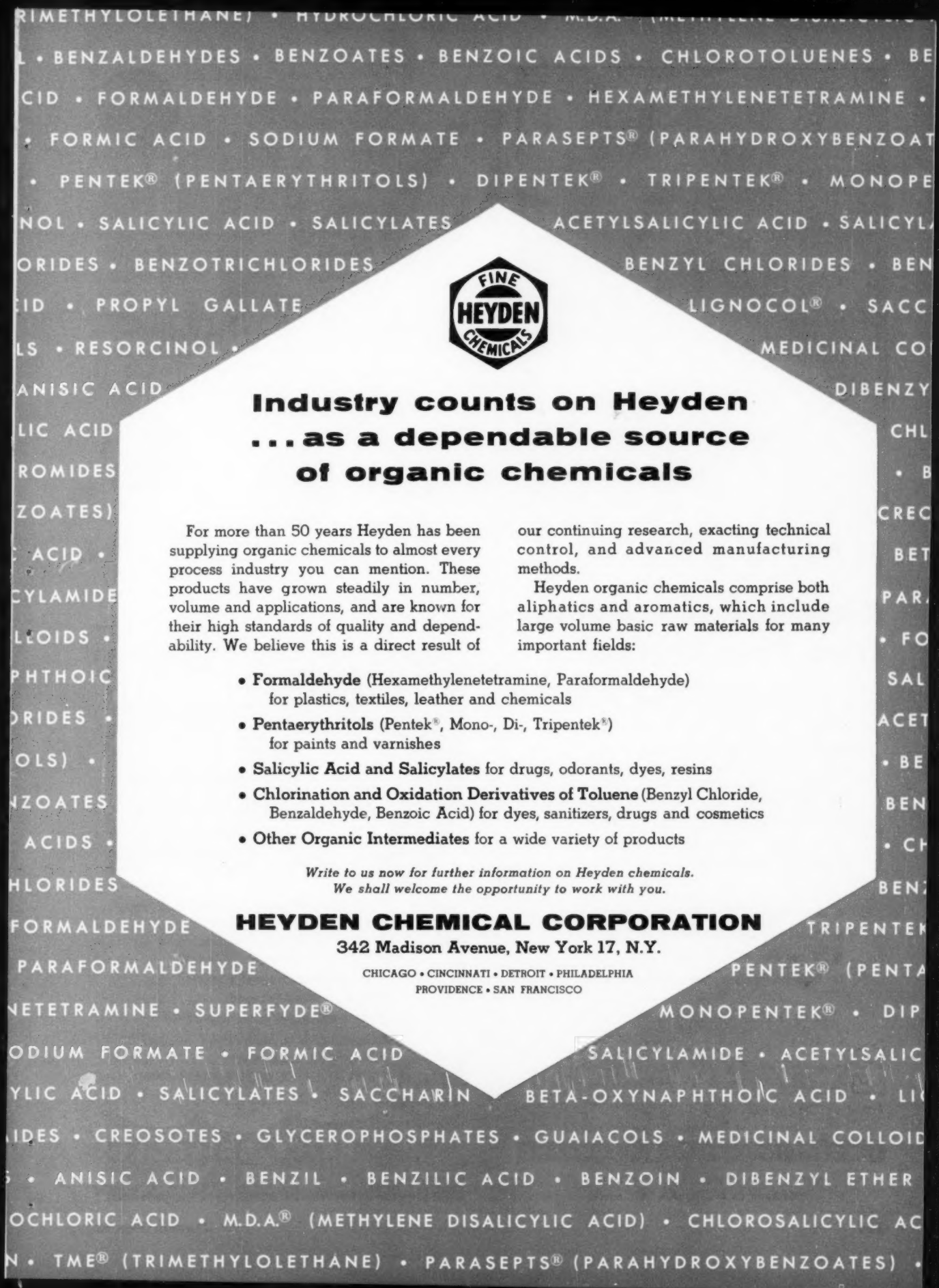

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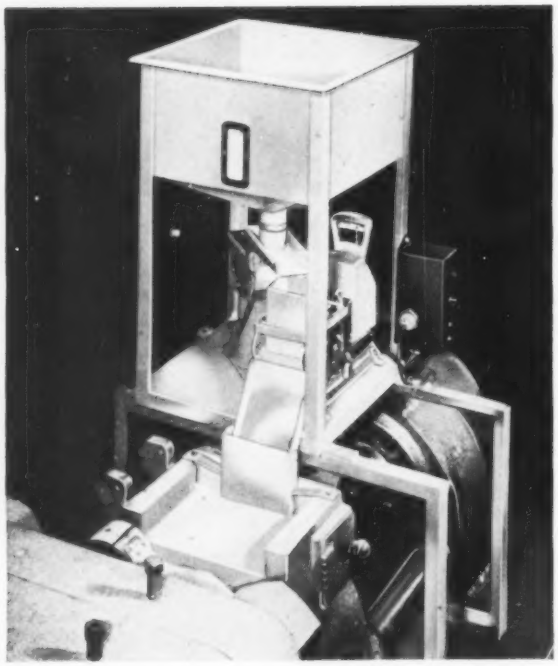

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Unitubo). U. S. 2,673,374, Mar. 30. Molding plastic tubes.

VENTILATOR. H. L. Omholdt. U. S. 2,673,513, Mar. 30. Plastic snap-on window ventilator.

FABRIC. L. P. Biefeld and A. R. Morrison (to Owens-Corning Fiberglas). U. S. 2,673,823-4-5, Mar. 30. Vapor-permeable fabric treated with phenolic resin.

LAMINATES. A. B. Ness (to Du Pont). U. S. 2,673,826, Mar. 30. Adhering surfaces of terephthalic ester polymers to one another.

ION EXCHANGE. K. G. Kohlstaedt (to Eli Lilly). U. S. 2,673,827, Mar. 30. Therapeutic ion exchange resins.

BATTERY SEPARATORS. F. Both (to British Fibrak Separator). U. S. 2,673,887, Mar. 30. Phenolic-impregnated fiber sheet battery separators.

MOLDING. J. Bailey and H. A. Pratt (to Plax). U. S. 2,674,006, Apr. 6. Mold blowing machine.

EXTRUSION. E. Allemann, E. Fritschi, and H. Leu (to Schweitzerische Isola-Werke). U. S. 2,674,007, Apr. 6. Extrusion machine for applying insulation on an electrical conductor.

POLARIZING SHEETS. F. J. Binda (to Polaroid). U. S. 2,674,159, Apr. 6. Light polarizing sheets.

COATING. G. L. Denniston (to Commonwealth Engineering). U. S. 2,674,584, Apr. 6. Dextran urea-formaldehyde composition.

PLASTISOLS. F. E. Condo and H. A. Newey (to Shell). U. S. 2,674,585, Apr. 6. Vinyl chloride plastisols.

COPOLYMERS. L. M. Welch (to Standard Oil). U. S. 2,674,586, Apr. 6. Oxidized isoolefin-cyclodiolefin copolymers.

PIGMENT. T. G. Leck (to Edgar Bros.). U. S. 2,674,587, Apr. 6. Pigment particles coated with phenolic resin.

MOLDING COMPOSITIONS. R. M. Price and A. F. Roche (to Dow). U. S. 2,674,588, Apr. 6. Monovinyl aromatic alcohol polymers.

BINDER. G. A. Coleman and L. T. Sutherland (to Allied Chemical). U. S. 2,674,589, Apr. 6. Low-flow short-cure phenolic resin.

RESIN. H. Zenffman (to Imperial Chemical). U. S. 2,674,590, Apr. 6. Thermoplastic aromatic polyphosphates.

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NEW MACHINERY AND EQUIPMENT

Injection Machine — High-speed, fully automatic, 2-oz. injection molding machine, Model 73-6, manufactured by Moslo Machinery Co., 2443 Prospect Ave., Cleveland 15, Ohio, may be arranged for manual, semi-automatic, and automatic repeat operations.

The machine is of horizontal construction, with four tie-rods, and has micromatic adjusting nuts for even distribution of pressure on four points of a toggle clamp. Dry-run speed is 1400 cycles/hr., with plasticizing capacity of 25 lb./hour. Material is fed from a 40-lb. hopper. The unit accommodates standard 8- by 9-in. mold blanks. The clamp has a capacity for clamping in excess of 20 sq. in. of molding area.

The material cylinder is of the Moslo Radee type. An enlarged safety gate engages a limit switch before the machine can be operated. An automatic compensating adjustable feed device controls quantity of material fed to cylinder. A counter timer is provided for packing the feed cylinder. Cycle is controlled by five timers, including one Cycl-Flex timer that controls the mold safety device and one Allen Bradley repeat cycle timer.

Mold clamp operating cylinder remains on low pressure until mold faces nearly meet. If there is an obstruction in the mold, the safety timer times out, setting up a circuit through a flasher to a warning light. The warning light flashes until an operator removes the obstruction.

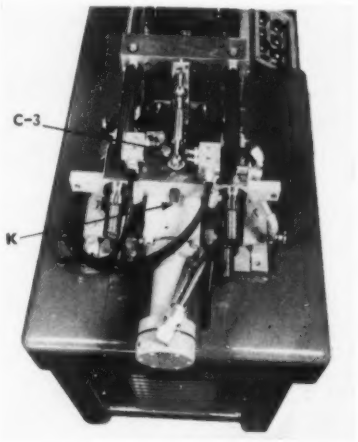
The machine has a newly designed hydraulic system, with all valves mounted on a hydraulic manifold, which is claimed to eliminate 60% of the pipe fittings normally installed with an injection molding machine.

In addition to the regular strainer provided on the pump intake, a micronic by-pass oil filter is installed in the oil tank, and double filtration is accomplished with cellulose filtering and Fuller earth purifying the oil. Oil is maintained refinery pure for the life of the machine, provided the filters are kept clean.

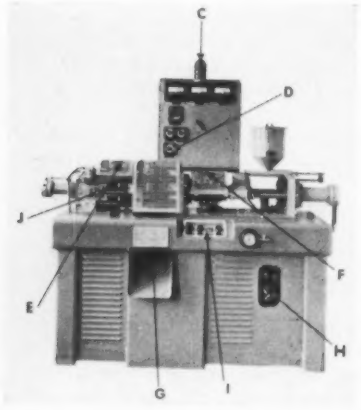
All electrical equipment, including three West pyrometric control instruments, timers, terminal blocks, fuse block, etc., are mounted in a two-door steel cabinet for wall or stand installation.

Specifications for Model 173-6 are as follows:

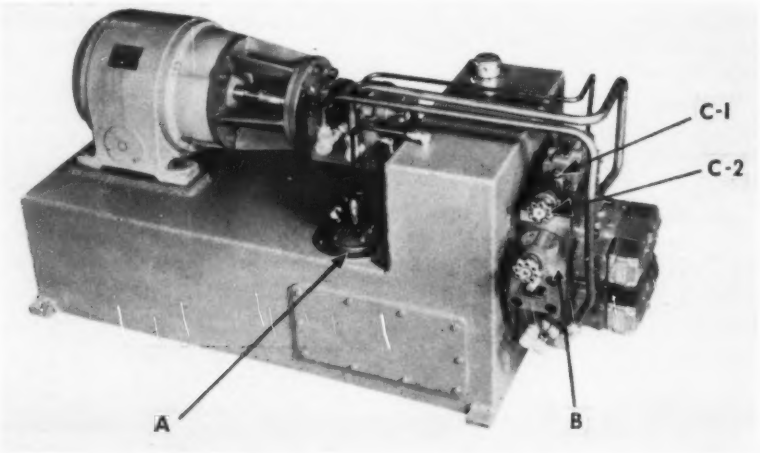
Injection capacity per shot	2 oz.
Rate of injection (cu. in. of material per sec., with booster)	7.0
Rate of injection without booster	2.87
Cycles/hr. (dry run)	1400
Plasticizing capacity (lb./hr.)	25
Maximum pressure on material at 1250 lb. on the oil (p.s.i.)	12,000
Mold size (in.)	8 by 9
Mold clamping area (sq. in.)	20+
Minimum mold thickness (in.)	5½



Top view of Model 73-6 injection machine (guards removed). K: vertical knock-out rods; C-3: safety limit switch control for turning on safety flasher light and operating low-pressure hydraulic system



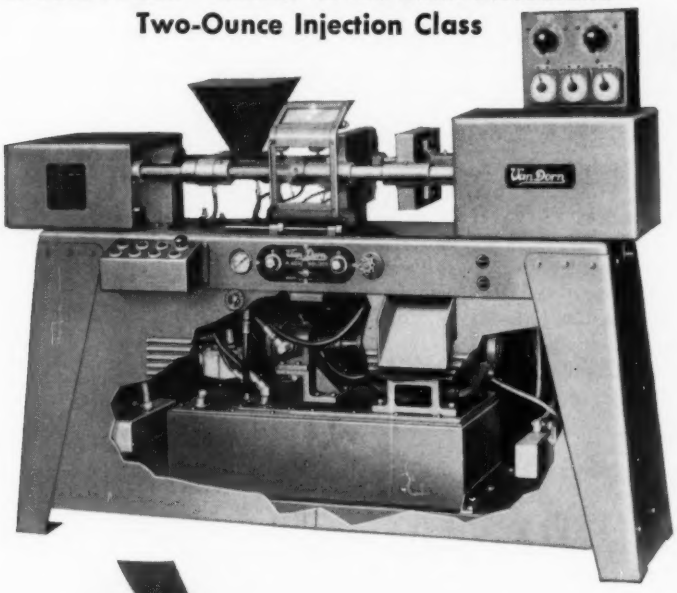
Over-all view of Moslo's 2-oz. automatic injection molding machine, Model 73-6. C: warning flasher light; D: safety warning light timer; E: safety gate cover at top of clamp; F: safety guard covers for cylinder heaters; G: delivery chute; H: relief valve access opening; I: recessed push-button panel; and J: horizontal knock-out rods



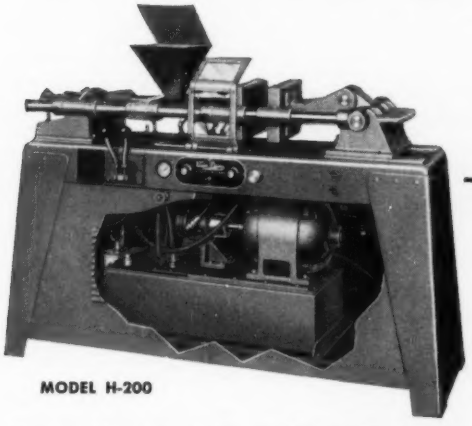
Close-up view of hydraulic system of Model 73-6. A: micronic by-pass filter; B: manifold assembly; C-1: low-pressure actuating valve; and C-2: low-pressure relief valve

Produce Plastics Profitably With This
VAN DORN Equipment

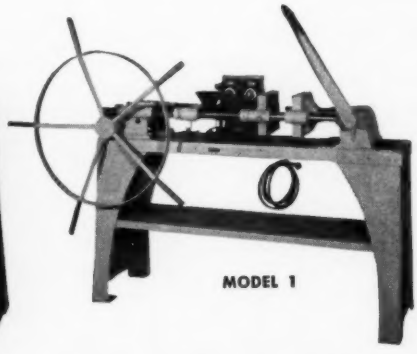
Model H-200—Leader in the Semi-Automatic Two-Ounce Injection Class



This ultra-modern press molds practically all thermoplastics including nylon. It completes up to 6 operating cycles per minute. Push button controls are safe, simple and convenient. Compact and rugged, the unit is quiet and economical in operation. Sliding gate with interlocking safety devices starts the cycle. Solenoid valves close the molds. Injection and dwell are controlled by first of three timers on the rear panel. Center timer regulates recharging of heater. The third timer controls the length of the mold close cycle; when time runs out, molds automatically open and parts are ejected. Operator opens safety gate, removes product and then closes gate to begin the next cycle . . . Variable voltage transformers in conjunction with thermostatic units control the temperatures on the two heating zones accurately.



MODEL H-200



MODEL 1

MODEL G-100

Power Operated, Lever Controlled Presses

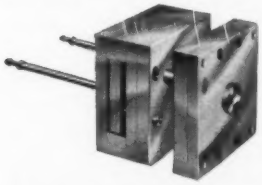
2-oz. or 1-oz. capacity. These low-cost units operate 8 hours for under a dollar and use inexpensive molds. Can easily be set up in twenty minutes by one man.

Manually Operated Press

1-oz. capacity. This press is ideal for smaller jobs, experimental work and technical training.

Plastic Grinder

Grinds up rejects, waste, etc., for re-use. Ruggedly made, designed for easy cleaning.



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Maximum mold thickness (in.) .. 8½
Mold opening (in.) 6
Hopper capacity (lb.) 40
Full-capacity power consumption of heating unit (amp.) 9.4
Motor size (hp.) 5
Size of machine ..... 89 by 29 by 65 in. high

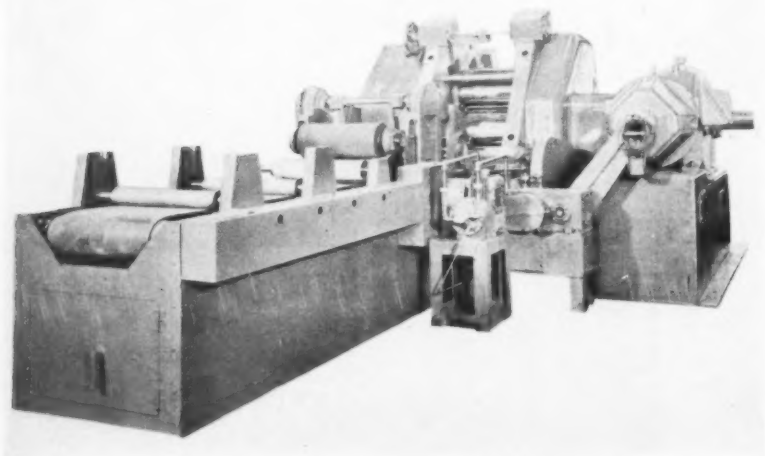
Press—Designed for the molding of reinforced plastics, a line of presses, ranging from 48- by 48-in. platen size with 78-in. stroke to 84- by 168-in. platen size with 138-in. stroke, has been introduced by Adamson United Co., Akron, Ohio.

Cylinder arrangement on these presses is said to permit opening and closing speeds of 300 to 400 in./minute. Pressing speeds vary from 3 to 18 in./min., controllable over 12 in. of travel. The machines have a unit pressure of 100 p.s.i. over the entire platen area. They are guaranteed by the manufacturer not to exceed 0.001 in. deflection per ft. of platen length (J.I.C. standard).

Calender—Designed for experimental work on plastics, rubber, and other materials, a six-roll 10½- by 20-in. laboratory calender can be used for thin film or heavy plastics sheeting. The unit is inclined at 20 degrees, with each pair of rolls inclined at 90 degrees in relation to the previous one.

Material can be fed to the top bank or to the bottom bank, permitting laboratory evaluation of arc of contact on finished film. Double coating work can be done by feeding between the third and fourth rolls, allowing each coat to be subjected to two passes before being laminated.

An electrically regulated drive provides a 10 to 1 speed range. A complete accessory train, incorporating cooling, slitting, and surface-type wind-up equipment is available.

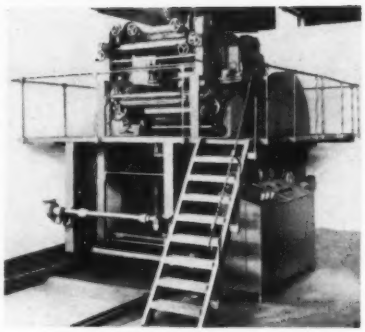


Adamson United's calender with take off and cooling rolls is designed for experimental work

Casting-Drying Assembly—Designed specifically for knife-coating a traveling web with thermoplastic or similar materials, and drying and fusing them on the web, Model 33 coater-dryer, produced by The Dornbusch Co., Krefeld, Germany, and distributed in the United States by F. A. Ringler Co., 418 W. 25th St., New York 1, N. Y., is also adaptable, with the addition of proper accessories, for embossing, polishing, or laminating. Width of the unit depends on maximum width of web, while length remains constant.

A paste casting head assembly permits application of resin either by fixed knife and rubber blanket or with air jet or air blade technique. A knife-coating head consists of two 6-in. diameter steel rolls that carry the endless rubber blanket. (When using the jet technique, the web travels unsupported by rubber blanket.) The assembly is powered by a rheostat-controlled 2-hp. d.-c. motor. The coating knife is vertically adjustable by spindles. Both coating knife angle and elevation are registered on convenient scales.

Fusing of the resin is accomplished by combined steam-heated drum and radiant heat panels. After fusing and drying cycles have been completed, the web passes over cooling drums equipped for water circulation.



Dornbusch casting-drying assembly can knife-coat traveling web, is adaptable for embossing, polishing, and laminating

The let-off is of the friction type, equipped with adjustable disk clutch for tension control. The rewind is individually driven by a 1½-hp. d.-c. motor, rheostat-controlled for constant tension.

Normal operating speed is 2 to 12 yd./minute.

Band Machine—Filing, polishing, deburring, slicing, and carbide tool finishing, in addition to sawing, are some of the operations that may be accomplished with a line of band machines and attachments and accessories offered by The DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.

The 16-in. band machine has a 12-in. thickness capacity. Frame construction is of heavy gage steel. A trunnion and cradle support a 24- by 24-in. work table which tilts 45° to right and 10° to left.

Models with fixed or variable speed controls with speed range between 50 and 5200 ft./min. are available.

Vacuum Forming Machines—Automatic, push button control of all operations is claimed for a line of vacuum forming machines introduced by Auto-Vac Co., 2116 Post Rd., Fairfield, Conn. The machines have automatic heater travel, automatic drape, automatic vacuum valves, automatic blow-off, automatic stripping, and automatic unclamping.

A universal clamping frame adjusts from 4 by 4 in. to the machine's capacity in 1-in. increments. A con-

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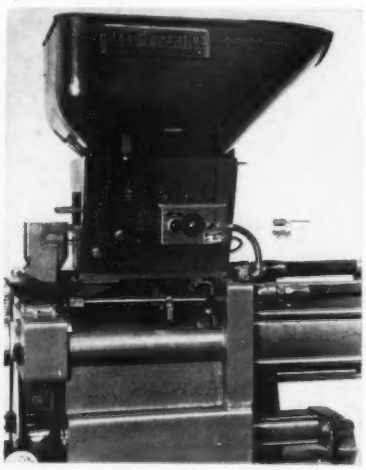
trolled power drive is adjustable in speed, thereby providing necessary controls so that different materials may be properly formed at the right speeds. The drape frame works on a synchronized toggle action principle, eliminating chances of misalignment. A drive adjustment permits draping from 0 to 12 in. in 1-in. increments.

The machines, which are also provided with manual controls, are made in a range of sizes from 24 by 36 to 48 by 72 inches.

Reflectors—For use with infra-red lamps, L L infra-red reflector units, produced by The Miskella Infra-Red Co., 7301 Grand Ave., Cleveland 4, Ohio, are said to be adaptable to heating jobs in the 500 to 1500° F. range. The units, with or without lamps, come complete with holders, insulation and, if necessary, cord and plug.

Hopper Unit—Developed by Reed-Prentice Corp., Worcester 4, Mass., for use with its line of injection molding machines, the "Reed-Weigh" is a precision weigh-feed hopper unit that accurately weighs each charge of thermoplastic material before depositing it in the injection chamber. Weight settings by vernier-type adjustment are said to be easily made and precisely maintained. Settings for each mold can be recorded for re-use in the future in the event that a molded item may be run again.



Reed-Prentice's hopper unit weighs each charge of thermoplastic material before depositing it in injection chamber

The hopper unit can be furnished

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on new 175T-4/6, 10D-8, 10D-12, 300T-12/16, and 400T-16/20-oz. machines, or installed in the field.

Voltmeter—Charges of static electricity on surfaces can be measured with the Statigun, an instrument which registers electrostatic charges in volts directly on the meter scale without making contact with the material being tested and without the use of probes. The meter is manufactured by Baldwin Instrument Co., Ltd., Dartford, Kent, England, and distributed in the United States by Herman H. Sticht Co., Inc., 27 Park Pl., New York 7, N. Y.

The principle by which the meter operates is that a small voltage, proportional to that being measured, is induced by capacitive coupling onto the grid of an electrometer tube. The anode current of the tube is measured by the indicating instrument, calibrated to read in terms of the inducing voltage divided by the distance separating its source from the instrument.

In operation, the instrument is pointed at the object which is suspected of having electrostatic charges, a trigger switch is pulled and, after the meter has been adjusted, according to operating instructions, the voltage gradient (v./ft.) is read directly from the scale.

Gage—For use on light materials, beta gage, Model BG-5, developed by Tracerlab Inc., 130 High St., Boston 10, Mass., utilizes a radioactive source of Cesium-137, an isotope having low-energy beta rays and a half-life of 33 years as its source. This combination of characteristics makes the gage well suited for use with lightweight materials and eliminates need for frequent source replacement.

The unit's 3-mg./cm.^{2} full scale sensitivity is equivalent to a weight change of 20 lb./3000 sq. ft. of paper, or a thickness change of 1.2 mils of plastics films.

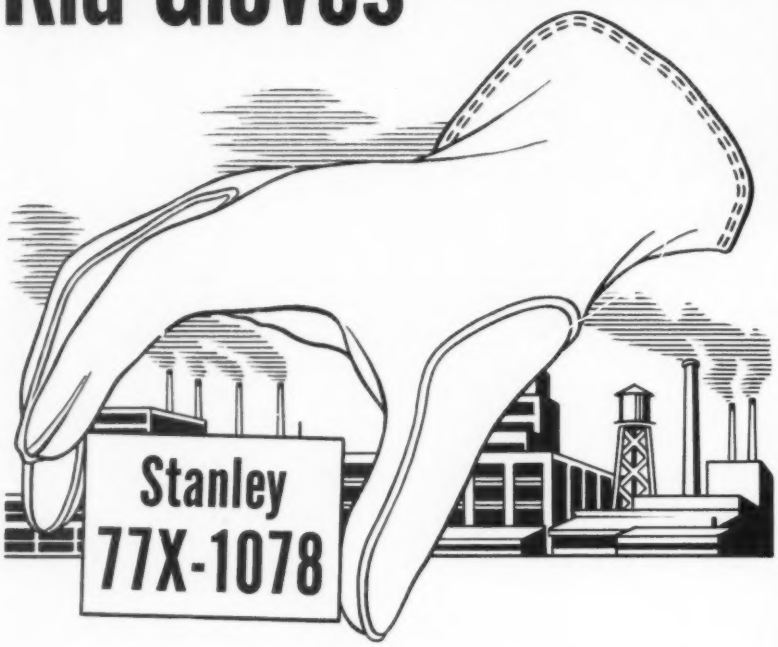
The gage is available with "C" frames having a variety of throat depths and all-angle scanning mounts.

Production Equipment—Processing of polyesters, epoxies, and other multiple-component resins can now be handled on a production line basis with equipment which automatically performs the functions of de-aerating, proportioning of resin and hardener components, mixing, and metered dispensing. The equipment, introduced by Applied Engineering Associates, 1952 Flushing Ave., Brooklyn 37, N.Y., is said to be capable of handling polyesters, epoxies, allyl resins, furans, modified phenolics, and polysulfide liquid polymers. Its present and potential future applications are in the fields of laminating; mat molding; matched die molding; plastics tooling; adhesives and sealers; potting, casting, and embedment; protective, decorative, and sealant coatings; and thermosetting extrusions.

Vacuum Forming Machine—Model 50-20 automatic vacuum forming machine, built by Vacuum Forming Corp., 76 S. Bayles Ave., Port Washington, N. Y., is designed for either drape or female forming operations. Each cycle is controlled by a series of interconnected timers. The machine can also be operated manually.

The unit is said to be capable of handling sheets up to 24 by 52 in., and has a maximum depth of draw

Kid Gloves FOR INDUSTRY



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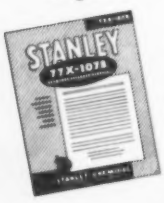

Write today for the new bulletin on 77X-1078 to the Stanley Chemical Company, 71 Berlin Street, East Berlin, Connecticut.

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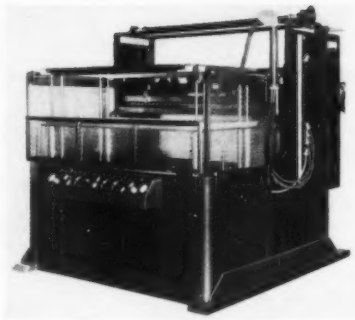

Vacuum Forming's automatic Model 50-20 accommodates sheets up to 24 by 52 in. for drape or straight forming operations

of 10 in. (if required, depth of draw can be made for a total of 15 inches). It has three-zone heating, each zone being individually controllable. The heater assembly is made up of Chromalox strip heaters; maximum temperature at which they will operate is 1200° F.

Each segment of the forming cycle can be increased or decreased in speed by opening or closing flow control valves, providing an additional control factor aside from the timers furnished with the equipment.

Capacity of the 3-hp. rotary-type vacuum pump with which the machine is equipped is 42 cu. ft./min.; total electrical load drawn by heater and motor is 92 amperes. Total weight of the unit is 3200 pounds.

Hydraulic Press—Specifically built for fibrous glass-reinforced plastics molding, a line of presses, manufactured by American Steel Foundries, Elmes Engineering Div., Cincinnati 29, Ohio, is made in standard capacities ranging from 50 to 300 tons.

Typical of this line of hydraulic presses is up-moving Model 8368, a press with 100-ton ram and 30-ton stripping capacity. This machine has an operating pressure of 2460 p.s.i., a 36-in. stroke, and accommodates molds up to 48 in. left to right and 36 in. front to back.

Operation of the press is push-button controlled. Press advances at a speed of 400 in./min. and, upon reaching a predetermined adjustable position, slows down automatically to the desired pressing speed. An adjustable timer can be preset for any length of curing cycle.

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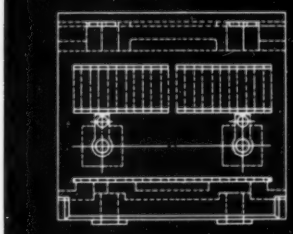
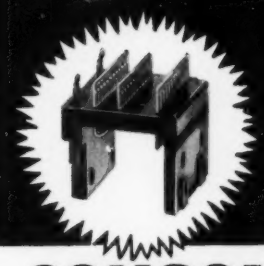
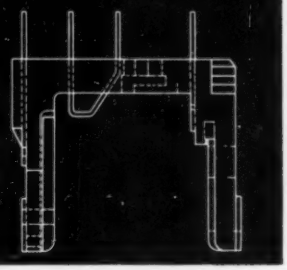


Custom Molding





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Oilgear's DXG-82506 variable-displacement, two-way piston-type pump, with three-position electric remote control. Flow of oil is reversed in the pump, making external control valves unnecessary.

Tester—Having a 75-in. daylight opening, Model L universal testing machine can be used to test tensile, compressive, transverse, and shear strength. It has capacity ranges of 0 to 250, 0 to 500, 0 to 1000, 0 to 2500, 0 to 5000, 0 to 7500, and 0 to 10,000 pounds. The instrument, produced by W. C. Dillon & Co., Inc., P.O. Box 3008, 14620 Keswick St., Van Nuys, Calif., is available in hand-operated or motorized models, in a choice of either 5- or 10-in. diameter dial sizes (in either pound or kilogram calibrations), and in a choice of gripping fixtures for plastics, rubber, cloth, metal, wire, adhesives, etc. The stand of the tester measures 22 in. wide by 38¾ in. high by 15 in. deep.

Mixer—Laboratory-size mixer for plastics and rubber, produced by Stewart Bolling & Co., Inc., E. 65th St., Cleveland 27, Ohio, has a capacity of 6 lb. of 1.5-gravity stock. The unit is equipped with "spiral-flow" sides for circulating water for cooling or steam for heating, and has a split-end frame for accessibility to rotors, bearings, shroud plates, and dust seals. Four-speed a.-c. motor or variable-speed d.-c. drive are available with the equipment.

Thickness Gage—Beta radiation gage Model S, offered by Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio, is designed to provide measurement for continuous process industries where rate of production is low or production is intermittent. The two basic components of the measuring system are a source detector unit which utilizes a radio-isotope to determine the weight or thickness of sheet material, and a control console. Sheets up to 24 in. width can be measured. Size of the detector is 36 by 10¾ by 24½ in.; dimensions of the console are 19 by 15½ by 13½ inches.

The unit incorporates an electrically-operated power supply, stabilized feed-back electronic amplifier, shock mountings for critical components, locked-in source with provision for alarm system, and standardized meter span sensitivity.

The company points out that this gage is designed to be a "high-class performer in the 'Ford' field of instrumentation."

Hydraulic Press—Corner-post, upward-acting, 15-ton laboratory-type hydraulic press for fibrous glass-reinforced plastics, Model 100, developed by Erie Engine & Mfg. Co., Erie, Pa., develops 1500 p.s.i. hydraulic pressure. Working platen area is 20 by 20 in., daylight is adjustable between 24 and 30 in., working height above floor is 36 in., and over-all height is approximately 70½ inches. The crosshead and bolster are both drilled for steam heating, and can be drilled and tapped for the attachment of molds. The pumping unit is a Racine-Seco combination, operating at 1800 r.p.m., with reservoir, 3-hp. motor, and all necessary valves, gages, timers, etc., to provide the following automatic speeds: closing—270 in./min. and 12 in./min.; opening—18 in./min., and 420 in./minute. Other makes of pumps are also furnished.

BOOKS AND BOOKLETS

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"American Chemical Industry," by Williams Haynes.

Published in six volumes by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. Publication year of last two volumes, 1954. Price of set of six volumes $76.00, individual volumes, $15.00.

With the publication of the last two volumes of this history of the American chemical industry, the most definitive work on that subject to date has now been completed. The work traces the development of the industry from its beginnings in the early 1600's to the start of World War II. The first five volumes cover the subject against the background of chemical, technological, economic, and political developments. The sixth volume presents in detail the roles played by over 200 individual companies in the growth of the chemical industry. In presenting all this pertinent historical data the author has managed to make his work not only an indispensable reference guide but also a book which can be enjoyed just for the story it tells. Foot-noted anecdotal material contributes to the value of the series. The work is broken down as follows: Volume I—1608 to 1900; Volumes II and III—1912 to 1922; Volume IV—1922 to 1930; Volume V—1930 to 1939; Volume VI—histories of individual chemical companies.

"Matthews Textile Fibers," sixth edition, edited by Herbert R. Mauersberger.

Published in 1954 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 1283 pages. Price: $16.50.

With developments in the field of synthetic fibers coming along so rapidly, this sixth edition of the well-known textile handbook has been brought up-to-date by including information on Orlon, Dacron, Vicara Dynel, Acrylan, and X-51, in the subject matter. The book also covers all the other man-made fibers, as well as animal, mineral, and plant fibers. The physical, chemical, and related properties, and the history, production, and utilization of each textile are detailed. This revision includes chapters on the X-ray identification of fibers, testing techniques, and economic and statistical data.

"The Future for Aromatic Chemicals," by W. W. Abbott, T. A. Christiansen, G. Gardiner, J. G. Lee, G. H. Martin, S. Miller, and R. J. Schaaf.

Published in 1954 by William Wallace Abbott, Harvard Business School, Boston 63, Mass., 131 pages. Price: $7.50.

This report was written as a group project by seven second-year students at the Harvard Graduate School of Business Administration. It is not a thesis and it is not a publication of the Harvard Business School. It is an assigned project in partial fulfillment of the requirement of one course. The study presents a classification and description of aromatic chemicals, analyzes present and future demands for them, outlines present and future uses, summarizes present and future sources of aromatics, and concludes with a delineation of guideposts for future development and effects of aromatics on national economy.

"Color Wheel for Color Planning," by Louis Cheskin.

Published in 1954 by The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. Price: $5.00.

This tool for color planning consists of a color wheel printed on heavy cardboard, showing 12 hues (colors without admixture of white or black) on an outer circle and 48 tints (hues mixed with white) on four inner circles. In addition, a transparent section, mounted concentrically on the printed color wheel, has five degrees of black (from 10 to 50%) printed on it. These blacks, when combined with each of the 12 hues, produce 60 shades and, when combined with each of the 48 tints, then produce 240 tones. Instructions that come with the color wheel explain primary, secondary, and complementary hues, related colors, and color harmony. Instructions for mixing and matching hues, tints, shades, and tones are given in detail.

"Toxicity of Industrial Organic Solvents," revised edition, by E. Browning.

Published in 1953 by Chemical Publishing Co., Inc., 212 Fifth Ave., New York 10, N. Y. 411 pages. Price: $8.00.

The effects of a variety of solvents used in industry on man and animal are investigated in this volume. The information on which the report is based was collected from widely scattered data published in books and scientific periodicals. Diagnosis of poisoning resulting from exposure to the toxic effect of various solvents and treatment for such conditions are discussed. The solvents covered include hydrocarbons, chlorinated hydrocarbons, alcohols, ethers, esters, ketones, glycols, amines, and others.

"Laboratory Instruments, Their Design and Application," by A. Elliott and J. Home Dickson.

Published in 1953 by Chemical Publishing Co., Inc., 212 Fifth Ave., New York 10, N. Y. 414 pages. Price: $7.50.

As a guide to the research worker who is called upon to construct his own laboratory instruments, this volume outlines the principles of good design and gives many examples of practical applications. The early chapters deal with the properties of various materials and their treatment and use in the construction of instruments. Succeeding chapters are devoted to methods of construction to suit special requirements, with particular emphasis on the kinematic design of instruments. Chapters are also included on vibration insulation, sensitivity, and methods of measurement.

Destaticizers—Anti-static agents, reportedly capable of permanently eliminating static electricity from plastics materials under normal conditions, are described in 4-page bulletin. Called Electrosols, the destaticizers come in both solid and liquid form. The material in its monomeric form can be incorporated into plastics materials, prior to thermosetting, or it can be introduced into the milling of plastics powders to make a product with built-in anti-static properties. The bulletin gives specific formulations

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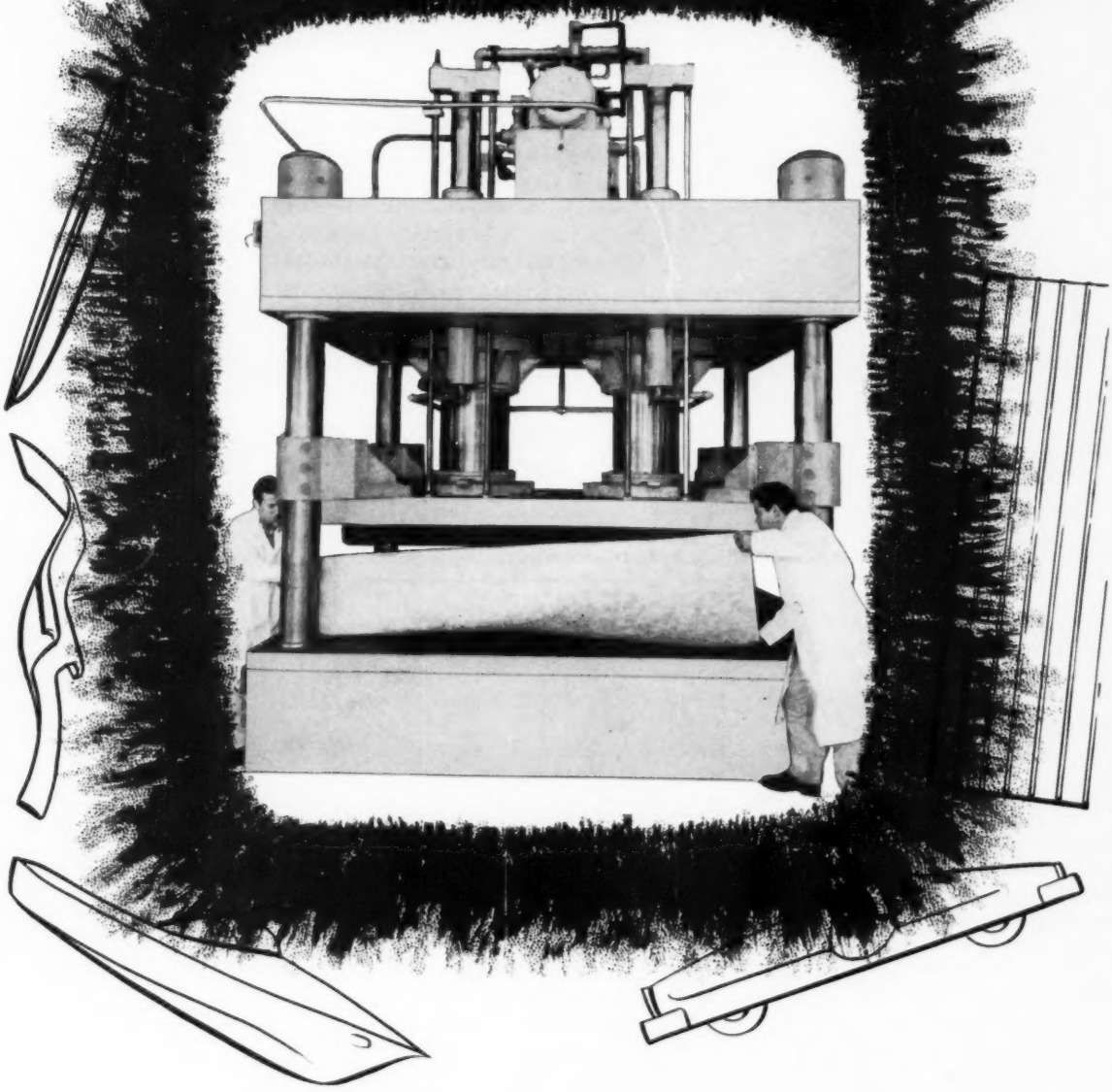

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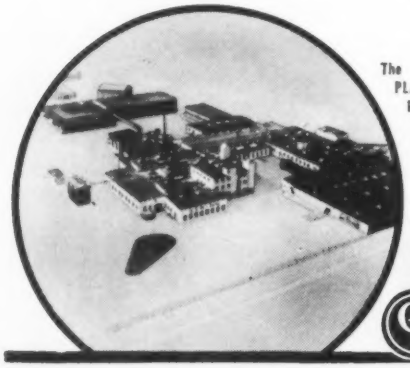

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KENILWORTH, N. J.

for use of the Electrosols with various plastics—they are claimed to be compatible with most plastics—and contains a table of physical properties. Applications of Electrosols in other fields (textiles, rubber, paint) are also given. *Alframine Corp., 4731 E. 52nd Dr., Los Angeles 22, Calif.*

Vinyl sheet—The versatility in application offered to designers and to fabricators in working with rigid vinyl sheet is described and illustrated in this 8-page folder, designated SA. Chemical, physical, and thermal properties of the material are included, as well as numerous photographs of actual applications. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 300 Madison Ave., New York 17, N. Y.*

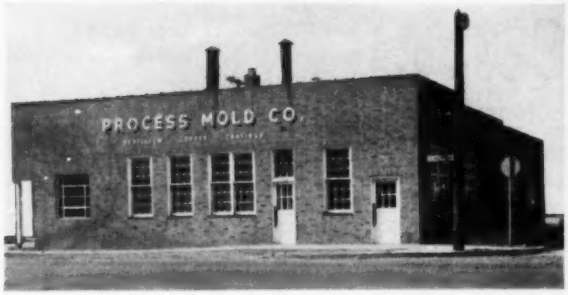
Merchandising aid—This 16-page bulletin introduces a series of full-color home service movies for use by stores in sales promotion, advertising, and sales personnel training, and makes specific suggestions on how to take best advantage of the films. Subjects covered by the movies include kitchen planning, bathroom decoration, plant and flower arrangement, care and storage of food, picnic and patio parties, and informal entertaining. *Monsanto Chemical Co., Plastics Div., Springfield, Mass.*

Winder—Trade-named Alquist, a winder, which is claimed to provide constant tension from start to finish in winding roll-fed materials, is discussed in this 4-page folder. The unit consists of a squirrel cage type three-phase, a.-c. motor, flange-mounted to a gear reducer, and operates independently of the main machine drive. Torque increase is sensed automatically as the diameter of the rewind material builds up and automatically decreases the speed of the motor in direct proportion. *Hobbs Mfg. Co., 26 Salisbury St., Worcester 5, Mass.*

Shell molding—Suggested for showings to foundry workers, vocational schools, colleges, and other interested groups, this 18-min. motion picture traces the development of resin shell binders and also describes techniques of shell production, shell assembly, and casting. Production methods ranging from simple manual operations to those involving automatic multi-station machines are covered. *Dept. SM, Monsanto Chemical Co., Plastics Div., Springfield, Mass.*

Dicyandiamide—Physical and chemical properties and typical applications of dicyandiamide are presented in this booklet. The product finds use in the manufacture of resins, dyestuffs, soap stabilizers, pharmaceuticals, paints, textile finishes, metal treating compounds, and antioxidants. *Manufacturers Chemicals Dept., American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.*

Glass-silicone laminate—Sheets and rods of staple glass fabric bonded with silicone resin (G-6) and sheets and tubes of continuous filament glass fabric bonded with silicone resin (G-7-1) are discussed in this 4-page folder. The former material is used where low electrical losses and good arc resistance are important; the latter, for use where higher strength and thinner sections are required. A case history of how the glass-silicone laminates improved



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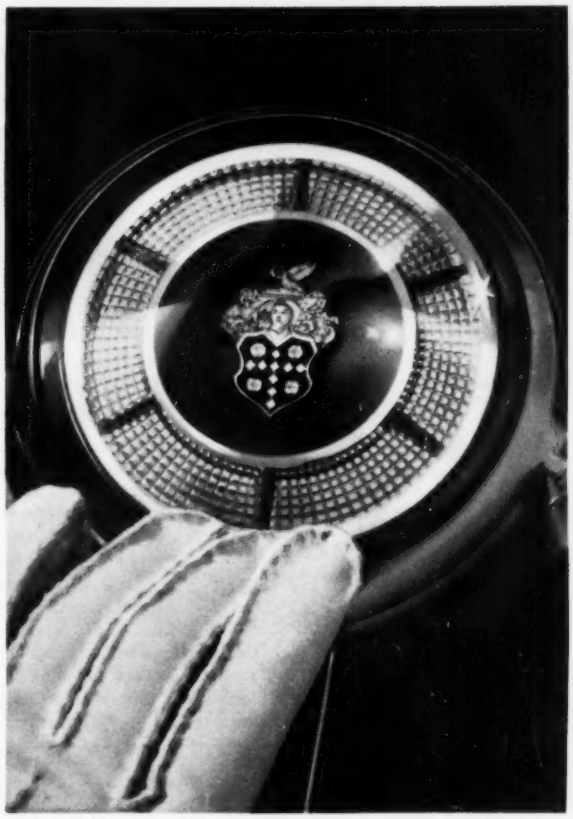

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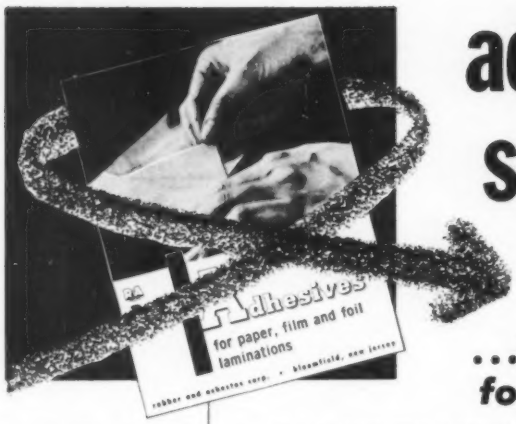

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performance of sealed dry-type transformers is included. *The Formica Co., 4614 Spring Grove Ave., Cincinnati 32, Ohio.*

Adhesives—Application information on various types of resorcinol-based adhesives are summarized in an 8-page booklet, entitled "Penacolite." Techniques for using Penacolite G-1124 (a room-temperature setting adhesive for gluing oak and other woods and non-wood materials) is outlined in Bulletin C-2-148. Schedule CS-56-F gives per-pound price information for Penacolite adhesives and hardeners in various-sized lots. Sales office addresses are also listed in the schedule. *Chemical Div., Koppers Co., Inc., Pittsburgh 19, Pa.*

Control accessories—This reference bulletin, entitled "Pyrometer Accessory Catalog," provides the necessary data to enable users to determine precisely the type of thermocouple and protective tube that would be needed for a variety of operations involving temperature control. Data are based on Instrument Society of America Recommended Practice 1.1 of Jan. 19, 1949. The outer margin of each page is indexed for easy reference to other sections of the catalog. Prices are included for each item. *West Instrument Corp., 525 N. Noble St., Chicago 22, Ill.*

Carbon blacks—Typical analytical properties, particle size data, and electron micrographs of 41 carbon blacks (channel, furnace, and thermal) are given in this second edition of "Cabot Carbon Blacks Under the Electron Microscope." Data provided for each black include Nigrometer scale, volatile matter, oil absorption, tinting strength, maximum moisture, apparent density, arithmetic mean diameter, surface average diameter, surface area from size distribution, and surface area from N_2 adsorption. The 100-page brochure also contains a discussion of the relation between particle size and properties of carbon blacks. *Godfrey L. Cabot, Inc., 77 Franklin St., Boston 10, Mass.*

Punches and dies—Factors to be considered in deciding on punch and die material to give the best results in tabletting operations are outlined in Bulletin 615. The bulletin depicts diagrams of seven tablet shapes for

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Manufacturers who want a shiny high polish or a rich matte finish on their vinyl sheeting can eliminate the necessity of an extra polishing run on an embosser by adding a Liberty Polishing Unit to their calender. The Liberty Polishing Unit works its magic equally well on virgin and reprocessed materials.

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which standard punches and dies are made and lists 196 sizes which are regularly carried in stock. A table on maximum safe pressures in tons on tablet machines punches is also included in the bulletin. *F. J. Stokes Machine Co., 5500 Tabor Rd., Philadelphia 20, Pa.*

Production control—Electronic temperature control for use with a variety of plastics production processes is described in this bulletin. The control system, Series 97, operates on the principle that the resistance of a wire-wound sensing element varies with changes in temperature. *Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. Fourth St., Philadelphia 33, Pa.*

Rigid vinyl sheet—Technical Data Booklet S-1 describes the forms, properties, fabrication techniques, and applications of vinyl plastic rigid sheets. It covers mechanical, chemical, electrical, and optical properties; preheating (including equipment), cold bending, hot bending and draping, blow molding, vacuum molding, plug and ring forming, compression forming (coloring, anti-static coating, over-lacquering, planishing, over-lamination); cementing and bonding; cleaning and polishing; and printing and marking. *Bakelite Co., a Div., of Union Carbide and Carbon Corp., 300 Madison Ave., New York 17, N. Y.*

Polymers for textiles — Brochure P-56 covers a line of aqueous system emulsion polymers designed for use by the textile industry. The line includes a wide range of polymer and copolymer compositions possessing varied physical and chemical properties. The brochure indicates advantages to be derived from the use of specific compositions. *American Polymer Co., Peabody, Mass.*

Organic acids—Booklet F-4768 discusses in detail the eight organic acids that are sold in commercial quantities by the company (acetic, butyric, 2-ethylbutyric, caproic, 2-ethylhexoic, crotonic, sorbic, and succinic). It gives physical properties, specifications, shipping data, and constant boiling mixtures, and cites many current uses. An entire section is devoted to the specifica-

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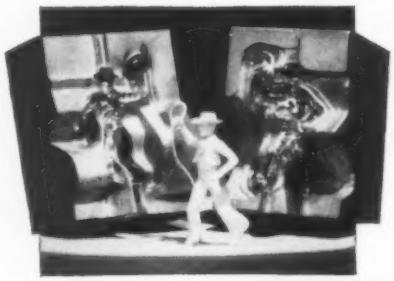

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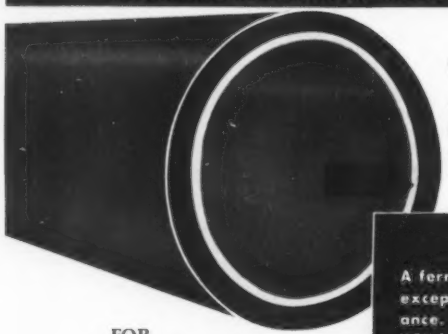

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tions and test methods used by the company for its organic acids. Selected references are included. *Carbide and Carbon Chemical Co., 30 E. 42nd St., New York 17, N. Y.*

Protective coatings—This 50-page booklet contains information of a generic nature on the subjects of chemical-resistant-type protective coatings. It discusses 11 types (Neoprene, vinyl, saran, epoxy, chlorinated rubber, styrene copolymer blends, furan, phenolic, alkyd, asphalt, and oil base) and gives their comparative resistance values, typical formulations, and application data. A number of reprints, dealing with coating fundamentals, are also included in the brochure. *The Atlas Mineral Products Co., Mertztown, Pa.*

Laminating press booster—Operation of a booster for use with a laminating press is discussed in "Hyd-Air," house organ of the booster manufacturer. An actual installation of the unit on an operating 9-platen laminating press is described. The booster provides high-pressure oil at 1700 p.s.i. for driving a 22-in. diameter press ram to obtain a laminating force of over 320 tons, and holds the pressure for the full 20 min. required by this particular laminating operation. The booster is driven by ordinary shop compressed air at 80 p.s.i. *Miller Fluid Power Co., 2040 N. Hawthorne Ave., Melrose Park, Ill.*

Iron-plastic—Technical Data Sheets PMS 28A and 28B give chemical and physical characteristics of a reduced-oxide iron powder-plastic material designed primarily for compacting parts requiring high tensile or transverse strength. Data are included on strength and other properties obtained with and without the use of copper, and a table lists the properties of sintered specimens containing various percentages of copper. *The National Radiator Co., Johnstown, Pa.*

Reinforcements—Weave structures of the company's fibrous glass reinforcements are discussed and illustrated in "A New Approach to Glass Fiber Reinforcements." The new approach consists in likening the fibers used in reinforced plastics to the grain in wood, i.e., just as grain gives wood its character, so glass

gives character to the appropriate resin. It is claimed that, for the best reinforced product, the inorganic "grain" of the fibrous glass must follow the same pattern pursued by nature in all plants and trees. *Modigliani Glass Fibers, Inc., 55 W. 42nd St., New York 36, N. Y.*

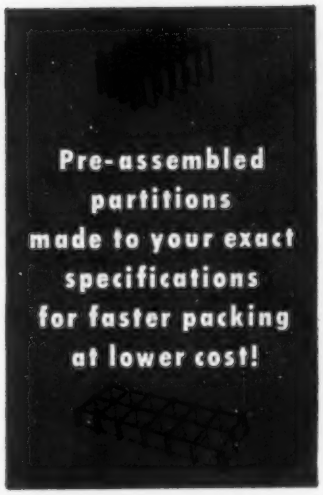
Achievement—Commemorating the tenth anniversary of the company's research laboratory, this 48-page booklet, entitled "Miracle of Research," relates the stories of the laboratory's accomplishments in the fields of synthetic rubbers, cold rubbers, oil enriched rubbers, polyester rubbers, conveyor belting, nitrile rubbers, accelerators, antioxidants, vinyl plastics, and other materials and products. *The Goodyear Tire & Rubber Co., Chemical Div., Akron 16, Ohio.*

Printed circuits—Functions, fabrication, and application of printed circuits are described in an 8-page brochure entitled "Why Wire?" Among the advantages cited for printed circuitry are lowered wiring costs, reduced assembly time, circuit reproducibility, and miniaturization. The brochure includes information on methods of application, materials, electrical characteristics, components (capacitors, resistors, tube sockets, switches, transformers, etc.), and dip-soldering assembly techniques. (See also "Wizardry in Circuitry," MODERN PLASTICS *31*, 8; Apr. 1954). *Photocircuits Corp., Glen Cove, N. Y.*

Teflon packings—Bulletin TP-454 catalogs a line of general-purpose Teflon packings, including braided pure Teflon, braided Teflon-impregnated blue or white asbestos, extruded Teflon packings, and Teflon bulk packing. Ordering information is given. Bulletin TP-1053 describes and illustrates V-type, cup-and-cone-type, and wedge-type valve packings and three types of pump packing rings—Teflon, Teflon with mica, and Teflon with graphite. *United States Gasket Co., Camden, 1, N. J.*

Melamine-formaldehyde — Catalog B-5878 covers all grades and forms in which industrial Micarta plastic is supplied and the chemical, mechanical, and electrical properties of each. The catalog is divided into three

partitions for **p**rotective **p**ackaging



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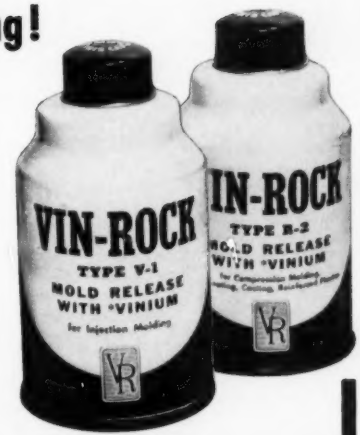

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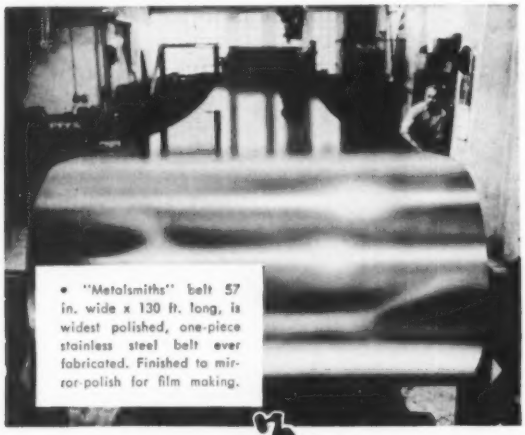

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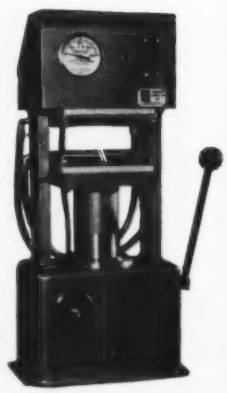

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sections: laminated Micarta, molded Micarta, and machining data. Design and application information is included in the first two sections. The machining section deals with punching, shearing, sawing, tapping, milling, stamping, and other fabricating operations. *Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.*

Glass mat—This product bulletin discusses a recently developed system of weaving glass fabric from roving, rather than from yarn, and enumerates the advantages it has over the latter (among them being absence of twist, better wetting, higher inter-laminate strength, and others). An actual sample is attached. The bulletin also discusses the difference between glass rovings and glass yarn. *Bigelow Fiber Glass Products, 140 Madison Ave., New York 16, N. Y.*

Gaskets—Bulletin TG-953 catalogs a line of Teflon-based gaskets and accessories for chemical-resistant piping and equipment. These gaskets are said to be impervious to all chemicals except molten alkali metals, fluorine at elevated temperatures, and chlorine trifluoride. The bulletin describes Teflon-jacketed gaskets, molded Teflon snap-on gaskets for conical and glass pipe, Teflon-jacketed adaptors for connecting unlike nozzles, Teflon expansion joints and flexible couplings, and solid Teflon ring gaskets and special shapes. *United States Gasket Co., Camden 1, N. J.*

Plastisols—Bulletin VP-1 gives physical and chemical properties of a line of plastisol compounds—combining the best characteristics of chemically inert vinyl plastics and rubber—for use in coating, casting, or molding. *United Chromium, Inc., 100 E. 42nd St., New York 17, N. Y.*

Russian plastics—The first two of a series of papers on the copolymerization of hydroxyethylallyl ethers of cellulose with sulfur dioxide by Soviet chemists, S. N. Ushakov and O. M. Klimova, are now available in English translation. The reports were originally published in the *Journal of Applied Chemistry of the USSR* in 1952. Report I describes the preparation and properties of mixed hydroxyethylallyl ether of relatively

low-substituted celluloses. Report II describes the treatment of the prepared ethers with sulfur dioxide in the presence of silver nitrate as catalyst. The hetero-polymers produced have properties which differ sharply from those of the initial components. The solubility of the copolymers obtained is directly dependent on the quantity of allyl group introduced into the cellulose. This indicates the possibility of controlling the properties of the copolymer by introducing different quantities of unsaturated groups into the cellulose and subsequently copolymerizing it with sulfur dioxide. Price for each report, $7.50. *Consultants Bureau, 152 W. 42nd St., New York 36, N. Y.*

German plastics—Abstracts of recent German patent applications in the field of plastics are offered in Bulletin 87. Translations of these applications can be obtained in report form at the prices indicated in the bulletin. Subjects covered by this service include acrylics, elastomers, vinyl and ethylene polymers, phenolics, alkyds, polyesters, plasticizers, and miscellaneous products and processes. *Research Information Service, 53 Nassau St., New York 5, N. Y.*

Controls—Bulletin 004 lists a complete line of equipment for the measurement and control of liquids and gases. Included are gages, manometers, recorders, meters, valves, Venturi tubes, and other instruments for use in water and sewage work and power and processing industries. Engineering drawings and tables of capacity data are also presented. *Simplex Valve & Meter Co., 68th and Upland St., Philadelphia 42, Pa.*

Fibrous glass on boats—Step-by-step instructions on the application of resin-impregnated fibrous glass coverings to boat hulls are given in this 24-page manual description of the "do-it-yourself" kit made by the company. The subjects covered are: preparation of boat surfaces, preparation of fibrous glass boat cloth and resin supplied in the kit, application of the reinforced plastic covering to hull surfaces, and special instructions for two- and three-ply laminations. Price $1.00. *Glass Plastic Supply Co., 333 W. Elizabeth Ave., Linden, N. J.*

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Production of

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PLASTICS AND SYNTHETIC RESIN PRODUCTION
From Statistics Compiled

Materials	*Total p'd'n. first 3 mos. 1954*	*Total sales first 3 mos. 1954*
CELLULOSE PLASTICS:[a]		
Cellulose acetate and mixed ester:		
Sheets, under 0.003 gage	4,392,267	4,223,520
Sheets, 0.003 gage and over	3,048,270	2,575,834
All other sheets, rods, tubes	1,423,755	1,293,360
Molding, extrusion materials	16,792,613	16,816,361
Nitrocellulose sheets, rods, tubes	1,822,402	1,484,889
Other cellulose plastics	1,422,736	1,199,954
PHENOLIC AND OTHER TAR-ACID RESINS:		
Molding materials[a]	50,220,767	43,949,479
Bonding and adhesive resins for:		
Laminating (except plywood)	15,961,074	10,644,487
Coated and bonded abrasives	2,334,019	2,536,210
Friction materials (brake linings, clutch facings, etc.	3,315,547	3,491,212
Thermal insulation (fiber glass, rock wool)	6,921,435	7,668,243
Plywood	7,786,018	7,548,251
All other bonding and adhesive uses	4,052,469	4,036,435
Protective-coating resins	5,615,508	5,446,374
Resins for all other uses	6,289,771	5,259,927
UREA AND MELAMINE RESINS:		
Textile-treating and textile-coating resins	9,108,501	6,269,913
Paper-treating and paper-coating resins	5,229,633	4,327,320
Bonding and adhesive resins for:		
Plywood	18,003,972	15,216,548
All other bonding and adhesive uses, including laminating	6,658,153	5,860,168
Protective-coating resins	6,464,514	4,471,931
Resins for all other uses, including molding	17,751,681	15,900,104
STYRENE RESINS:		
Molding materials[a]	77,995,743	78,714,266
Protective-coating resins	19,715,062	19,357,182
Resins for all other uses	23,572,968	21,541,447
VINYL RESINS, total[b]	126,748,226	123,052,848
Polyvinyl chloride and copolymer resins (50 percent or more polyvinyl chloride) for:		
Film (resin content)		17,387,945
Sheeting (resin content)		17,945,062
Molding and extrusion (resin content)		33,085,242
Textile and paper treating and coating (resin content)[c]		13,809,992
Flooring (resin content)		3,512,818
Protective coatings (resin content)		5,472,096
All other uses (resin content)		6,529,339
All other vinyl resins for:		
Adhesives (resin content)		6,485,054
All other uses (resin content)		18,826,300
COUMARONE-INDENE AND PETROLEUM POLYMER RESINS	39,745,521	48 886,742
MISCELLANEOUS:		
Molding materials[a,d]	48,462,721	40,509,991
Protective-coating resins[e]	1,378,472	999,387
Resins for all other uses[f]	27,587,433	29,093,046

* Dry basis is designated unless otherwise specified.
** Partially estimated. † Revised.
[a] Includes fillers, plasticizers, and extenders. [b] Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c] Includes

Plastics Materials

of the same company, and for sale. Sales include only the quantities involved in bona fide sales in which title passes to the purchaser.

IN POUNDS* FOR FEBRUARY AND MARCH 1954
by U. S. Tariff Commission

*February***		*March***	
Production	*Sales*	*Production*	*Sales*
1,336,179	1,168,089	1,602,752	1,745,406
1,071,029	794,239	1,138,677	1,031,322
408,750	388,157	559,446	470,620
5,167,946	5,064,816	6,257,292	6,069,271
597,795	459,867	661,945	501,169
486,387	435,027	523,887	299,064
16,086,744	14,232,330	18,901,987	15,062,409
†4,747,116	3,159,799	5,832,032	4,201,644
688,510	806,790	815,570	840,786
984,034	1,035,709	958,157	1,213,681
2,060,422	2,146,369	2,564.377	2,990,375
2,729,902	2,726,631	2,587,969	2,406,431
1,111,768	1,052,067	1,228,260	1,229,286
1,740,455	1,683,985	2,077,572	1,880,561
1,578,851	1,517,831	2,763,558	2,368,857
3,090,619	2,228,140	3,168,450	2,497,539
1,643,422	1,454,155	1,835,299	1,284,166
6,443,605	5,009,496	6,410,207	5,809,207
2,325,516	1,604,446	2,456,270	2,098,694
2,066,368	1,403,799	2,294,477	1,482,431
5,644,743	4,907,215	6,087,387	6,102,015
26,011,308	23,857,095	28,351,133	30,086,793
6,184,533	6,070,711	6,854,982	6,752,211
7,364,287	6,589,127	8,901,314	7,643,845
39,809,528	40,102,550	46,302,532	45,819,393
	5,169,694		7,348,279
	5,720,128		6,789,829
	10,710,550		12,254,523
	4,346,100		4,826,153
	1,170,418		1,431,752
	1,829,210		2,028,824
	2,407,098		2,391,647
	2,037,626		2,621,876
	6,711,726		6,126,510
17,471,734	15,824,741	17,940,292	18,079,339
15,578,696	12,887,000	17,057,642	13,807,588
689,089	309,419	350,612	346,771
9,555,492	9,426,779	9,322,977	10,250,624

data for spreader and calendering-type resins. [d] Includes data for acrylic, polyethylene, nylon, and other molding materials. [e] Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins. [f] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

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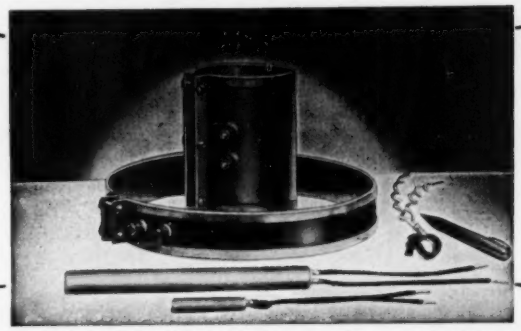

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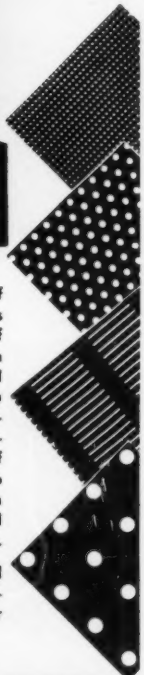

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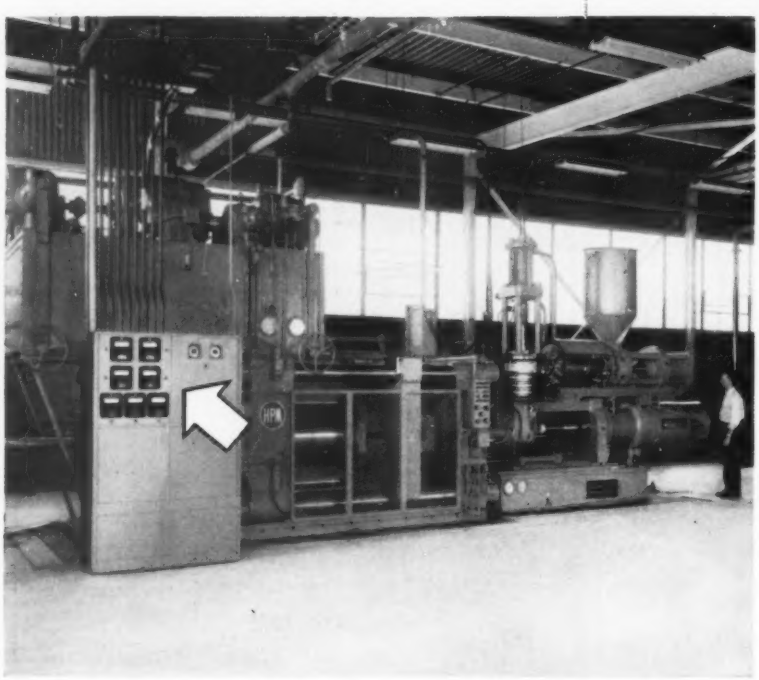

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Melamine housing for electric shaver is molded in two-tone color combination

Shaver Housing

BY SPECIFYING melamine-formaldehyde for molding the housing of its new de-luxe "Custom" electric shaver, Schick, Inc., has taken advantage of the mechanical strength and color potential of the stainproof and scratch-resistant material to improve the operation and appearance of its compact, streamlined unit.

The dielectric strength of melamine, coupled with its resistance to heat, also contributes to the efficiency of the new shaver. Because of melamine's rigidity and dimensional stability, the housing also serves as the main chassis without requiring reinforcements or supporting wall sections.

The sides of the shaver housing are molded of beige color material. A molded-in grid pattern on the side faces makes it easier to grip and hold the shaver. The top and cover for the shearing heads are molded in grey-brown, completing a color combination styled to coordinate with any bathroom color scheme.

Claimed to be the thinnest electric shaver on the market today, the "Custom" model combines mechanical improvements in the power unit with the natural light weight of melamine to reduce size and weight for easier handling and greater convenience in use.

CREDITS: Parts for the Schick "Custom" are molded by Shaw Insulator Co., Irvington, N. J., and Waterbury Cos., Inc., Waterbury, Conn., using Melmac supplied by American Cyanamid Co.

Styrene Display

AN eye-catching point-of-sale display, molded of crystal styrene, is designed to promote the new U. S. Royal golf ball being marketed by United States Rubber Co.

The glamorous display, which resembles a faceted diamond, is individually boxed and supplied to golf pros, for whose shops the display is primarily intended, completely set up and ready to be placed on the counter.

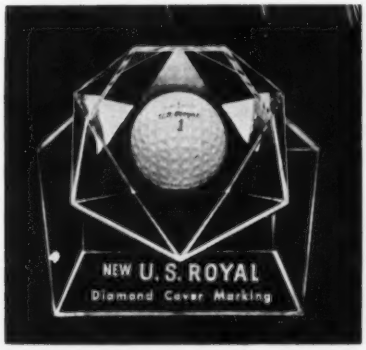
The display is injection molded in three parts—the four-sided base and the two halves of the prismatic enclosure. Each half of the enclosure is identical in shape and each contains 12 reflecting facets.

Before assembling the display, the inside surface of the bottom half of the enclosure is coated with silver by vacuum deposition. The 12 metallized facets in this section thus become 12 mirrors which reflect the golf ball from 12 different angles. The bottom half of the enclosure, with a piece of velvet material set into its base as a background, is then cemented to the base of the display. The golf ball, with a hole drilled in it, is positioned on top of the velvet material and a screw is driven through the base of the display and into the hole in the ball to hold it in place and prevent it from shifting about.

Finally, the top half of the enclosure is cemented over the bottom half, completely enclosing the ball and protecting it from dirt and dust during the life of the counter display.

CREDITS: Display was designed and molded for United States Rubber Co. by Cowan Boyden Corp., Providence, R. I.

Crystal clear display, molded of styrene, protects golf ball from dust and dirt



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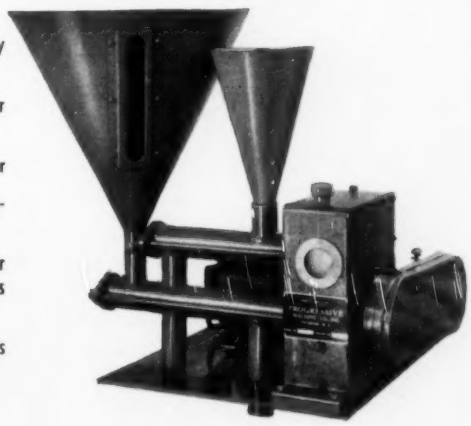

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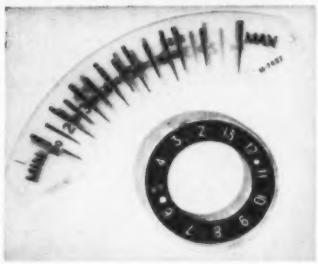

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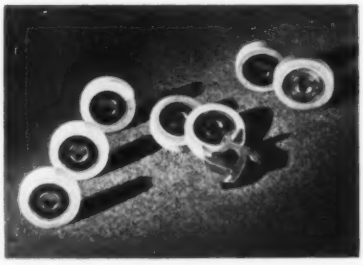
Roller Guide

LINEN-BASE phenolic laminate roller guides—non-abrasive and wear-resistant—have been adopted as standard equipment on a new line of carbide-tipped trimming tools.

As an integral part of the trimmer, the plastics guides, in replacing the steel rollers previously used, have considerably improved the operation of the tool. The trimmer is used to smooth down the rough edges of laminated plastics (or Masonite, linoleum, or plywood) table tops, counter tops, or similar areas that have been cut to size. When the trimmer is in use, the function of the roller is to follow along the wood base of the laminate sheet and guide the trimmer on straight edges and around corners.

The light weight of the laminate is also important to the effective operation of the tool. Since the roller guide starts to spin when the trimmer blades are set in motion



Phenolic laminate rollers guide metal blades (center) of new trimming tool

and continues spinning until pushed up against the wood base and stopped by friction, the heavier the roller guide the more heat will be generated while the spinning action is being arrested. The lightweight phenolic laminate guide, consequently, is easier to stop and less likely to cause discoloration of the laminate by the heat generated.

The plastic roller is compressed by machine over a standard $\frac{5}{16}$-in. metal bearing. Unlike the steel rollers, which had a tendency to slip off one side of the bearing, the plastic laminate can be pressed on uniformly tight.

CREDITS: Trimmers are available from Price & Rutzebeck, Hayward, Calif. Phenolic laminate supplied by Spaulding Fibre Co., Inc., Tonawanda, N. Y.

Compact camp trailer, in towing position behind car, is 12 ft. long and stands only 4 ft. high. Lightweight reinforced plastics trailer body is dentproof and rustproof

Trailer Expands for Sleeping Quarters

RUGGED in construction, a new reinforced plastics camp trailer with the low sweeping lines of a modern car is designed so that it can be expanded into comfortable sleeping quarters for three people.

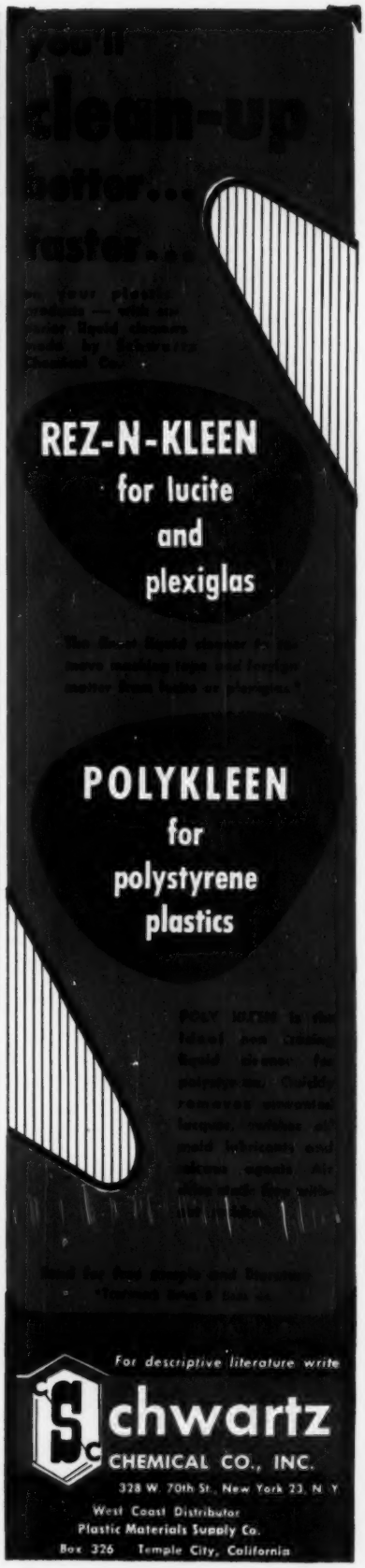
In towing position behind the car, the dentproof, rustproof plastics trailer body measures 12 ft. long, almost 7 ft. wide, and only 4 ft. high. A hand crank, located in the front of the unit, is used to raise the trailer body to a height of 6 ft., 3 in., when it is to be used for camping. Sturdy metal braces support the molded reinforced plastics roof, and canvas sides extend from the roof to the base when the trailer is expanded.

There are two fixed bunks in the trailer and a "pull-out" third bunk which is fitted into a special section in the rear of the trailer. The camp trailer is also equipped with self-contained fuel unit, two-burner stove, built-in refrigerator, 15-gal. water tank, two mattresses, and cupboards. The canvas sides, which are removable, have windows for cross ventilation.

Fully equipped, the trailer weighs only 1100 lb.—much less than the weight of a conventional camp trailer. Because of the light weight and the low riding position of the trailer, it handles well on the road.

CREDITS: Trailers are made by Hille Engineering Corp., Anaheim, Calif., using Vibrin polyester resin supplied by Naugatuck Chemical Div., United States Rubber Co.

Expanded camp trailer stands 6 ft., 3 in. high. Two bunks are located inside trailer; third bunk (left) pulls out from rear. Canvas rolls down to enclose sleeping quarters



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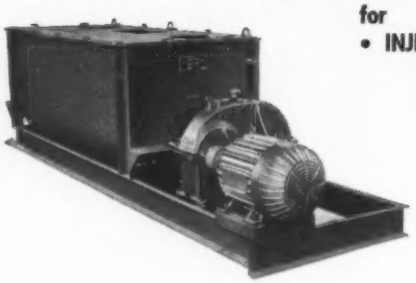

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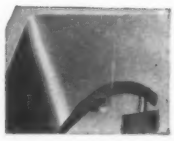

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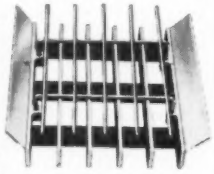
The grate can readily be lifted out for removal of tramp iron and debris. The Magnetic Grates are available in sizes from 2" x 4" up to 8 feet square. Any size or shape can be furnished to meet unusual requirements.



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Transparent, tapered polyethylene bags make efficient packages for umbrellas

Tapered Bags

POLYETHYLENE, a fast growing favorite in packaging applications has entered a new market area in that field, thanks to a recent development in fabricating equipment which makes possible the high-speed mass production of tapered, transparent polyethylene bags or sleeves.

Prior to this development, little use was made of tapered polyethylene bags in the packaging field, despite the fact that a considerable number of articles, by nature of their shape and contour, could greatly benefit from such sleeves, both in terms of high visibility as well as lasting protection.

One of the main reasons for this lack of tapered polyethylene bag packaging was the fact that the hot-wire process used for sealing the seams of tapered polyethylene bags was a relatively slow operation and did not lend itself to high-speed production. With the new equipment, this difficulty has been overcome.

While details of the equipment are not available for publication, it can be revealed that the process, although retaining the hot-wire sealing method, is capable of production speeds of up to 60 bags per minute. Fully automatic, the newly developed equipment makes possible polyethylene bags in a variety of lengths with any degree of taper, using film up to six mils thick.

Packaging applications include umbrellas, gloves, scissors, saws, neckties, pliers, and other articles with tapered contours.

CREDITS: Bags fabricated and equipment developed by Better Bags, Inc., Philadelphia 23, Pa.; untreated polyethylene film supplied by E. I. du Pont de Nemours & Co., Inc.

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Lacquer Adhesion

IN THE development of the Eastman Kodak Lumaclad reflector reported in the March 1953 issue of MODERN PLASTICS, one of the major problems was to find a base lacquer having good adhesion to the Tenite butyrate molding. A lacquer composed largely of a butyrated-type urea-formaldehyde resin of the second stage solvent-type, catalyzed with a phosphoric acid amine catalyst, was found to give satisfactory results.

However, in the course of this development it was found that the addition to the lacquer of a small percentage of an ion exchange resin having polar characteristics tended to improve the adhesion. Beneficial results were obtained by adding polar substances to the spraying and dipping formulations. The mono-esters of polyglycols having a varying free acidity and free alcoholic content are examples of the type of polar resins used. The cleate esters generally have a positive polar charge and the laurylate esters are characterized by a negative charge.

Where a base coat and a top coat are used, a cationic ester was used in the base coat and a non-ionic ester was used in the top coat. A typical formulation of these resins is as follows:

Base Coat

Urea-formaldehyde resin	25%
Butyl alcohol	10%
#1 denatured alcohol	64%
Catalyst: butyl phosphoric acid	1%
Sotex CS	2% of urea-formaldehyde resin content

Top Coat

Urea-formaldehyde resin 75%	18%
Epoxy resin 25%	41%
Toluol	41%
Cellosolve acetate	2% of total resin content
Sotex 3CW	

The Sotex resins listed in the above typical lacquer formulations are produced by Synthetic Chemicals, Inc., Paterson, N. J.

Studies were also made and some satisfactory results obtained by incorporating polar substances into the base plastic molding itself and then using the same principle for the base lacquer coat.—*Garson Meyer, Eastman Kodak Co., Camera Works.*

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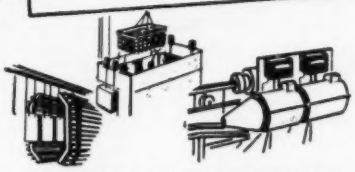

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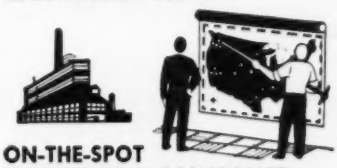

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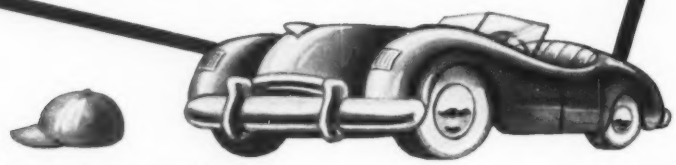

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CREDITS: Tape is extruded by The Garrison Co., Kenilworth, N. J., using Geon vinyl supplied by B. F. Goodrich Chemical Co., Cleveland, Ohio.

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COATED PLASTIC SHEETS. Folder contains samples of printed, coated, metallized, embossed, and adhesive-backed sheet cellulose acetate and polystyrene. Coating Products. (G-413)

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Problems of Color

(*From Page 71*)

rates and with higher uniformity. All of these should be credited with these advances. Through association in task forces established by major technical societies, such as the American Society for Testing Materials and the Society of the Plastics Industry, improved specifications and methods of test are constantly being established. Many of the new ideas inherent in these improvements spring from the more fundamental accomplishments of scientists in such groups as the Optical Society of America, and the American Chemical Society.

But this expansion and exploitation of the scientific method to color and to coloring methods needs continued encouragement. Much useful know-how lies buried in the literature. A good share of it is basic physics and chemistry needing only persistent application to show the way to improved quality and performance at lower costs.

Colorant Effectiveness

For example, it would be a major assist to plastics colorists everywhere if a standard method of testing and expressing "money value" of colorants were made available. By this is meant the actual coloring "strength" or effectiveness of a specific colorant per dollar cost. With such a rating in common use, confusing claims and misleading prices per pound would be less likely to prompt unnecessary testing and misguided use of colorants. By the same token, reliable indices might well be developed—for the colors obtained, and for resistance to color-changes, under extended exposures to light of various sources, at temperatures of processing, molding, fabrication, extrusion, and in contact with selected materials of varied physical and chemical reactivity, including the plastic vehicles themselves. Perhaps a worthwhile objective would be the preparation of a "colorant index for plastics" comparable in scope and content to the encyclopedic "Colour Index" now being made available in a new edition by the (British) Society of Dyers and Colourists, primarily for the textile industry.

A case in point here is the selection of colorants for plastics used in the already immense, but still rapidly growing, field of food-packaging. Aside from reaction between colorants and foods leading to rancidity of odor and taste, with or without unpleasant discoloration, there is the problem of potential toxicity. Because of the difficulties and costs of analyzing for traces of materials in colorants which may cause these objectionable, if not dangerous results, reliable rules for selecting and incorporating colorants for this purpose are not readily available. There are some indications that compounding colorant and plastic does not completely "insulate" the colorant particles from the contents of the package. It follows that continued exposure may permit reactions to occur. Here, indeed, is a largely unexplored and possibly troublesome sector in plastics coloring.

Within this major field is a more specialized, but certainly equally important sector, that of the selection of colorants for color-matching itself. Traditionally this process has been an art. As such, it has been dependent upon the highly developed but subjective skills of the color-matcher, particularly his perception and memory of color and color-differences. The application of basic relations in physics to this problem has resulted in techniques of spectrophotometric "quantitative" color matching. These provide dependable systematic solutions to the most difficult color-matching problems. These methods are naturally costly in terms of initial capital investment for equipment, and they require trained technical personnel, but they pay off over the longer range by establishing competence, reliability, and independence of less flexible artisans generally next to impossible to obtain or replace.

HUE is the basic color of an object, determined by dominant wavelength.

VALUE refers to the degree of brightness or cleanness of a color.

CHROMA relates to purity of color, based on the various amounts of other colors mixed into it.

The persistent pressure of plastics materials into ever-widening fields of application has led to the design of newer methods and variations of production. All of these are related in one way or another to coloring. Their objectives are increased output and flexibility, improved color uniformity, and lower direct and indirect manufacturing costs, without restricting either the sizes of orders for specific colors or the gamut of colors with the best selling power.

Methods of Coloring

For discussion here, without regard to specific types of plastics, coloring methods may be conveniently classified as those used by 1) the major materials manufacturers, 2) converters, frequently using some proportion of reworked materials, and 3) the fabricators, those producing printed, molded, or extruded parts.

The Major Materials Manufacturers naturally provide the most elaborate facilities designed to obtain the highest, most consistent quality, for the broadest coverage of the industry's needs, in accordance with the recognized industry-wide price schedules. Because coloring is only one of many technical phases in the larger scale operation, it is here that we find the major effort to control coloring to the same extent that characterizes more easily quantified processes. Even so, much remains to be done. Many unpublished investigations of production know-how continue, with the goal of streamlining coloring so that it becomes a mass-production technique. Improved combinations of personnel, processing equipment, and physical forms of colorants are continually being sought. Perhaps this technology is now rising in stature to the point where publication of fine details will not be considered as loss of know-how, but as an opportunity for further discussion and improvement.

As indicated previously, production's coloring costs reflect some factors beyond its control. One of these is the prior selection of the color itself, largely in the realm of sales' decisions. Long runs of a few colors describe the production man's dream, but shorter runs of specific colors, produced and delivered on time for his customers' applications, are the salesman's targets. Wide tolerances mean high production

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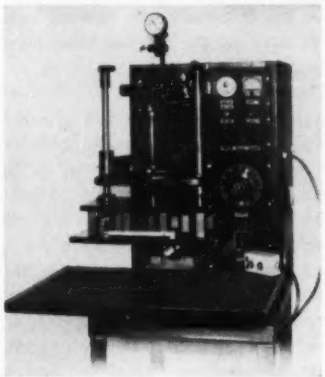

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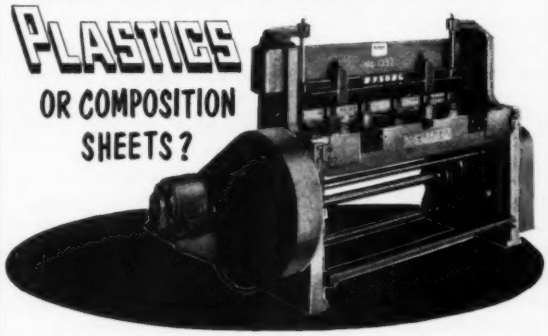

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yields and low costs, but many large-volume fields require extremely narrow color tolerances if sales are to continue. As a result, production costs for such categories are higher, and the need for close control greater, if such business is to be gained. Succeeding articles will show many approaches to this challenging problem.

What is remarkable is the variety of ingenious techniques that have been devised to meet the need for effective production methods of coloring plastics. The colorants, as we shall see, are available in a variety of forms—manufactured powders generally much finer than 325 mesh, dry dispersions in any one of a variety of compatible solid vehicles, and pastes in liquid carriers such as plasticizers. Processing equipment includes endless varieties of tanks, blenders, mixers, roll-mills, extruders, and combinations thereof. Farseeing is the organization which is set up to provide study to select the best combinations.

Perhaps the "automatic (coloring) factory" is not in the far distant future even in this presently empirical field. Photoelectric instrumentation for inspection of colored materials is an accomplished fact, despite the fact that its widespread application is making only slow (though steady) progress. Equipment is available for the automatic measurement of continuously produced colored materials. Its coordination with other production controls of regulating color lies ahead.

The Converter is concerned mainly with coloring accumulations of reclaimed plastics materials and/or previously unused material purchased from the major materials suppliers. This coloring material is generally, but not always, smaller and simpler than that of the major materials manufacturers. While organizations in this field vary widely, they are such that price, rapid delivery of smaller orders, and other aspects of special customer service are generally emphasized more heavily than long-run uniformity.

Their reclaiming of used material into a form of commercial value is a highly useful function. In this operation, sorting of grades of scrap materials and blending of quantities to obtain larger volumes of greater utility and effectively higher quality are most important. Here one may find a different economic balance than may be used by the larger manufacturers in the selection of colorants. For example, the reliable heat and light stabilities of colored inorganic pigments may sometimes be considered expendable and costly luxuries. As a result, these may be replaced by considerably cheaper and somewhat less stable, but still effective, combinations of dyes, organic pigments and opacifying pigments. Naturally this careful adjustment of the color quality to end-use requirements is a major problem which cannot be allowed to drift out of control.

Fabricator Coloring covers a wide range of operations, from "surface coloring" by metallizing, printing, and lacquering of previously colored or uncolored plastics to "mass coloring" during molding or extruding of sheets and profiles. While advances have been made in all these techniques, perhaps the greatest has been that frequently labeled "dry coloring." Although a few progressive molders have been organized to provide their own coloring of this sort for a decade or so, it was not until 1949 that "dry coloring" by molders became relatively accepted. This widespread expansion of plastics coloring was fostered by the development of raw materials especially formulated for this purpose by the major manufacturers. Significant also was their release of coloring know-how and related information previously more or less restricted. In addition, major assistance was provided by several smaller colorant manufacturers and processors equipping themselves to provide the particular kind of colorants and services required by these fabricators.

While an average person can see approximately 500,000 different colors, a spectrophotometer is mathematically capable of distinguishing 10^{91} (10 followed by 90 zeros) colors, say scientists, who hastily add that there aren't nearly that many.

This change has probably resulted in a net increase in the total tonnage of colored plastics, solely by reducing the cost of coloring. But it is not without problems. At this stratum of the industry one finds the most rudimentary facilities for coloring. At the same time, as the fabricator's business succeeds, these facilities are expanded and improved to the extent that they may rival those of the larger and longer established converters and materials manufacturers. Such development generally follows recognition that coloring is a complex determinant of quality and costs, and as such cannot be given only casual attention.

This type of coloring has focused closer attention to the costs of coloring. While it theoretically transfers the problem of manufacturing larger numbers of smaller orders of individual colors, by no means is this problem eliminated. The molder may limit his coloring facilities to a bare minimum. He then finds that his supplier of colorants—which are generally mixtures of colorants carefully blended to match a desired color—passes on his understandable charges for the direct services and overhead charges required to produce such standardized combinations of colorants. In some cases, these charges could be such as to eliminate the savings over using molding powders colored by the materials manufacturer. One primary reason for this lies in the fact that for certain colors requiring relatively high concentrations of more costly colorants, his costs will be more realistic than the "average" cost for all colors, which helps fix the materials producers' price schedule.

It follows then, that in general, for greatest economy, the smaller fabricator providing his own coloring facilities uses the lowest amount of the least expensive colorants which will do an adequate job. As his organization grows, he may seek to avoid the processors' service charges by buying his colorants singly and in bulk quantities from the primary colorant manufacturers.

Conclusion

This last development of fabricator coloring has the salutary effect of forcing closer scrutiny of the fundamental relations between quality and costs. Both of these factors should ultimately be improved by widening the basis of participation in coloring plastics. At the same time, this evaluation has greatly increased the need for a broader dissemination of know-how. Filling precisely this need may be the major and most lasting contribution of the following articles.

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Color Surveys

(*From page 72*)

voted for a chartreuse set of dishes, but months later when she is actually in the market for dishes she selects pink because of the setting.

IV: Survey of Related Lines

Still another method of making color surveys is to look into related lines to be introduced by manufacturers. Here the consultant makes a study of all home furnishings manufacturers in allied lines to learn their plans. In contrast to the sales record technique, this offers a projection of the related colors to be featured.

Today there is, in general, a consistency in home furnishings color trends, which simplifies the homemaker's job of correlating furnishings within a room. The advantage of this method is that it helps the consultant select colors which will harmonize with other furnishings purchased by the consumer.

V: Survey at Fashion Level

The fifth general category of surveys is that based on the opinions of the country's leading stylists, decorators, designers, and home furnishings editors.

This research must be handled by one who is experienced in interpreting color trends, separating the extremely high styled trends from those having mass market possibilities. This requires very careful analysis and broad and well-established contacts with fashion leaders. By the very nature of the work, this type of survey requires long-range study to obtain the rhythm of color preference.

The expert conducting a program at this level must be familiar with and actively participate in all markets, fashion openings, introduction of new products, nationally publicized openings of new homes, and other important events in this field.

Advantages and Limitations

Inasmuch as each of these color survey techniques has certain advantages and limitations, it appears that a combination of all five methods will provide the most accurate and valuable information. Certainly more than one technique appears to be always desirable.—END

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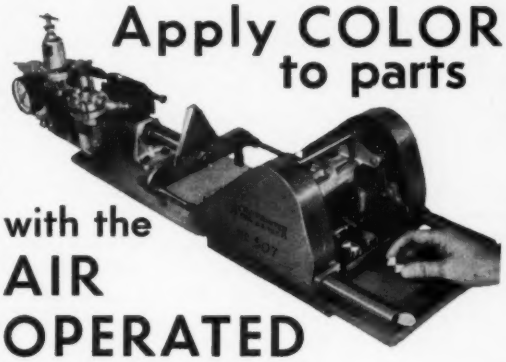

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Color Sells

(*From page 73*)

specifications, and at the same time permits permanent exact coloring.

Manufacturers are finding that plastics have all of these features as well as many additional advantages found in no other product.

More dynamic color effects are possible with plastics because they can be molded with almost any degree of translucency so that they seem to radiate color and glow with their luster.

Color Merchandising

It is true, color sells, but it won't sell itself. Like the light hidden under a bushel, merchandise improperly displayed does little good.

Manufacturers may use the most appealing colors in the world, but if stores fail to display the merchandise with an understanding of color harmony the results will be poor indeed.

I know of one manufacturer who brought out a line of household goods molded in colorful melamine plastic. The colors chosen were based on the results of a consumer survey; but when the products were introduced into retail stores, the initial sales in some stores were considerably below expectations, while in other stores sales were very good.

A quick investigation provided the answer.

The stores with the best sales had a well organized color merchandising program with thought given to the impact of color displays. In the less successful stores little attention had been given to the use of color and the products were not displayed to their best advantage.

Color in displays cannot be ignored, because color has a tremendous influence on our whole outlook and thus on our buying decisions.

As an indication of the importance of colors in selling, Dr. Ernest Dichter of the Institute of Mass Motivation Research recently said, "The use of an exciting red in cosmetic packaging conveys harshness when such products should convey delicacy and smoothness."

I am reminded of the experience of the Brunswick-Balke Collender Co. which had some trouble selling billiard tables during the depression despite the fact that people were then almost entirely entertaining themselves at home. A color expert advised the company to change the green felt to a soft purple. The company did, and sales shot up. The reason—women associated the green of the tables with gambling games and the "dishonest atmosphere" that they created, and would not have them in their homes.

Actually color and light for display purposes are almost synonymous because the color as seen by the eye is dependent on three factors:

1. The natural color of the object as it would appear in the daylight.
2. The color of the light shining on it.
3. The color of the surroundings.

It is, therefore, obvious that the store lighting itself can definitely affect the prospective purchaser's reaction to the merchandise displayed.

Not all store lighting equipment will produce the same effect. Incandescent lights have a much warmer color, enhancing and giving warmth to red and orange and thereby making them even more desirable. Cooler fluorescent lights add beauty to green and blue color products. This is particularly true if they are made of translucent plastics.

Some of the most effective single unit displays that I have seen employ sharp contrast. Gaily colored products are placed against dark background, warm colors against colored backgrounds, and pure colors against gray.

When a display includes a number of colored products, a neutral background should be used and care should be taken not to combine uncomplementary colors. For instance, a wine-colored and orange-colored set of melamine dinnerware are each attractive in their own right, but displayed side by side they each lose attractiveness due to the combating influences.

Time and again I have noticed that the department store displays which seem to draw best attention have a bright background, but in many instances the prospective customers, while drawn by the background, are not particularly interested in the product itself. Gaily colored products displayed in a darker background draw attention to themselves while the background makes details of the product more visible.

The cash register seems to ring more merrily when darker shades are used behind the products especially when they are properly balanced in hue to give the product more visibility. The opposite is true of many light backgrounds which may distract from the product. The darker the background, the lighter the displayed products will appear.

Here is a method of avoiding a distracting background while highlighting the product: Choose the same color as the product for the background, gradually reducing the intensity and blending the background out to lend atmosphere but not to attract attention away from the product. This approach may be a little too subtle to be effective where vivid contrasts are required, particularly for mass markets, but it can do a good job with class items.

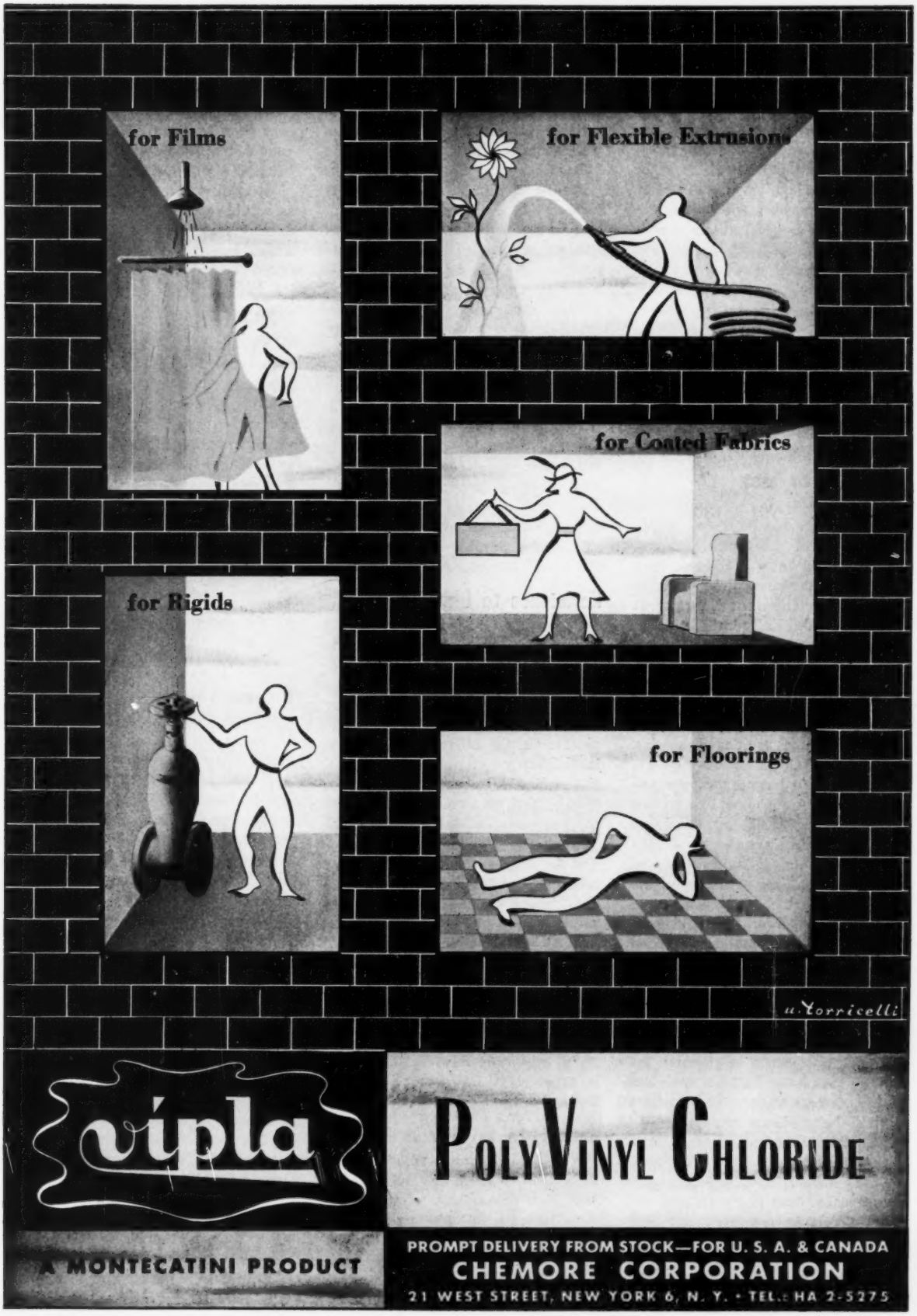
Color Schemes

One of the important color research jobs done every year is the selection of the *House and Garden* code of new colors, developed annually by that magazine for the home furnishing field.

Each year the *House and Garden* colors are promoted by hundreds of department stores and thousands of home furnishing and specialty hardware stores, in addition to a long list of major manufacturers. It is important to note that the color preferences of American buyers change sharply from year to year and so manufacturers and merchants must be constantly alert to keep in tune with the color times.

Experience indicates that there can be a color relationship between those portions of products which are made of plastic and other portions made out of other components. Because plastics offer manufacturers the opportunity to mold the plastic portion of their products in bright, true, gay colors, that portion is often the one to carry the heaviest part of the color load. We have recently seen new food blenders in which the plastic housing is made in bright kitchen colors which blend nicely with the metal and glass portions. Even toasters are now highlighted with brilliantly colored plastic portions.

When it comes to colors there is no substitute for taste, judgment, and the facts. But taste and judgment must be guided by factual information as to consumer preferences and consumer reactions to the colors used.—End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Types of Colorants

(*From page 75*)

ments for chemical stability differ in degree and nature for colorants added before as compared with after a polymerization or condensation step; for re-worked as against virgin stock; and for pharmaceutical containers as against cake boxes. Alkali resistance is highly important for colorants for floor tiles and washing machine impellers, whereas acid resistance may be needed for battery cases. Dyes for shoe-heel films or fountain pen barrels must meet glass and solubility specifications that are of less importance for electrical goods, while the latter uses may have very important specifications for chlorine content and dielectric properties.

Resistance to Heat

The heat resistance of colorants is profoundly affected by the nature of the vehicle, the colorant concentration, chemical inter-reactions, time cycles, pressure, accessibility to oxygen and other, often local, factors. It is difficult and usually impractical to try to isolate the effect of heat from the other factors of environment. Many colorants will withstand heating for a few minutes at high temperatures in some media, but not many will stand prolonged heating periods (see Color Plate, Fig. 1). Most organic colorants will decompose if held more than five to ten minutes above 525° F. and nearly all will break down erratically at 550° F. In production, it is important to know the actual temperatures of the heated stock, which on occasion have been found to differ from the gage readings. In most cases, trial runs in the plant equipment are safer criteria than laboratory heat tests.

Resistance to Light

The lightfastness or color permanence of a colorant is affected not only by the plastic medium itself but by the concentration of the pigment or dye, the presence of supplementary compounding, curing, or stabilizing agents, and numerous other factors. As classes, dyes are generally less lightfast than pigments and organic pigments are generally less lightfast than inorganic pigments, but there are notable exceptions to such a generalized statement.

Some colorants darken when exposed to light in full color, while others fade. Most of the colorants that are sensitive to light fade more severely when compounded at low concentration or in tints with opaque white. The nature of the opaque white pigment frequently affects the fading of colors.

Figure 2 illustrates a graphical method that has been found convenient for comparing the relative lightfastness of colorants in plastic compositions. In this figure two typical red pigments, each useful in vinyl plastic compounding, have been compared over an exposure period of 400 hours. The author has found this method quite useful in research work, particularly with plastics that continue to change color on storage so that physical reference samples are relatively short-lived and unreliable. It consists merely of using Nickerson's Fading Index formula (4), which is based on easily made Munsell Color Order (3) readings, to calculate a number that represents the total hue/value/chroma change.

Resistance to Bleeding

Comments regarding bleeding characteristics are based primarily on direct color bleed into the type of solvent mentioned. In actual use the colorants often receive a considerable degree of protection from the plastic. On the other hand, even an insoluble pigment may seem to bleed if the liquid tends to dissolve the plastic itself, since most colorant particles are too small to be distinguished individually. It is impractical to predict the degree of bleeding that may take place with mixed solvents from data based on the solvents tested singly. Many plastic polymers have distinct solvent effect on certain organic pigments or dyes, and plasticizers and plasticized compositions are particularly prone to cause colorant bleed. Elevated temperatures generally promote bleeding and may cause migration, bronzing, crocking, or other related faults to develop in the colored plastic.

Resistance to Chemicals

Most of the comments regarding resistance to acids and alkalies are based on actual tests of the colorants with 5 to 30% hydrochloric acid, 5% soda ash solution, and 30° Bé caustic soda. The effects of aldehydes on colorants are based on their resistance when used in urea-aldehyde and/or phenolic aldehyde molding compositions. The reactions to oxidizing and reducing conditions are based chiefly on the known chemistry of the colorants and general experience, and should be accepted with some reservations because of the influence of the various plastics in which they may be used. In actual compounds, the plastic will usually provide some protection for the colorant.

THE GENERAL RESISTANCE PROPERTIES OF COLORANTS

Organic pigments, synthetic inorganic pigments, natural inorganic pigments, and dyes are useful in the coloring of plastics. Each group has several subgroups and many individual members that differ to such an extent that generalities can serve only as a rough guide in the selection of plastics colorants. Some of the certified dyes and pigments are useful in plastics where toxicity is an important consideration. The properties of these specialized colorants have been published elsewhere (5, 8, 9). Only the properties of those dyes and pigments that have important application are discussed herein.

Organic Pigments

As a colorant group, the organic pigments are characterized by wide color range and good brightness, very limited solubility in most commonly available liquids, and much greater resistance to bleeding than dyes. Individual organic pigments, of course, differ widely in their resistance properties and adaptability for coloring plastics. They are generally most useful for plastics for interior applications.

Lithol reds are widely used where moderate resistance suffices, as in rubber and various thermoplastics. They exemplify the influence of the metal precipitant on pigment properties, as color, heat, and bleedfastness tends to increase in order from sodium to barium to calcium.

Certain beta-oxy naphthoic acid (BON) reds, the lithol rubines, pigment scarlet, and to some extent the barium toners of Lake Red C comprise a group having sufficient heat, light, and migration fastness to adapt them for coloring heavily plasticized compositions.

Toluidine, para and chlorinated para toners, Brilliant Red Lake

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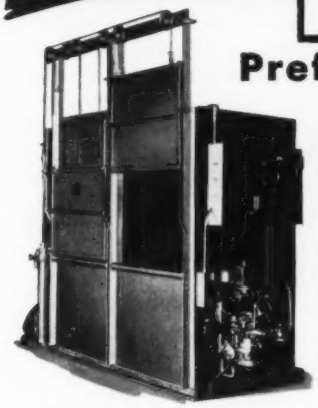

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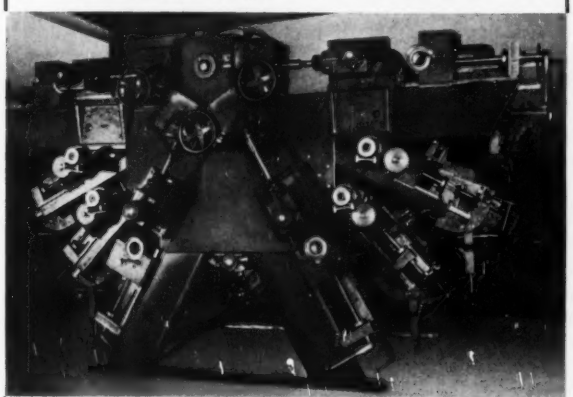

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R, bronze orange, and the ortho-nitraniline and dinitraniline orange toners comprise a pigment group having moderate to good heat and light resistance, but which have very poor migration resistance in plasticized stocks. They are useful colorants chiefly for amino-plastics and some cellulosic esters.

The benzidine oranges, benzidine yellows, and Hansa yellows have moderate to good resistance properties. However, they must be used with discretion. For example, the Hansa yellows give excellent results in urea-aldehydes but effloresce from many thermoplastics.

The phthalocyanine greens and blues have resistance properties which meet the requirements for coloring a great variety of plastics. However, their antioxidant effects somewhat inhibit the curing of peroxide catalyzed polymerization. Where suitable otherwise, the chrome greens and iron blues exert much less antioxidant effect. Certain types of phthalocyanine blues tend to lose tinctorial strength on aging in some media, perhaps due to crystal growth or flocculation (see Color Plate, Fig. 1).

The phosphotungstic acid, phosphomolybdic acid, and tannic acid toners of the basic dyes have generally good resistance to heat and aldehydes but rather poor resistance to light and most reagents. Migration in vinyl plastics is likely to occur. They are sometimes preferred to dyes, but in general the latter are equally useful and lower in cost.

Acid dye lakes are usually formed on alumina hydrate substrates. They are reasonably resistant to heat and aldehydes, but resistances to light and migration are poor. The corresponding dyes usually show better lightfastness than the lakes but are generally harder to disperse.

Carbon blacks have excellent fastness properties, and large quantities are used for improving the weather and abrasion resistance of rubber and polyethylene plastics. However, they may act as antioxidants in certain plastics and tend to inhibit the functioning of peroxide catalysts.

Synthetic Inorganic Pigments

This is a large group of chemically formed pigments, mostly metal oxides, sulfides, or chromates. Both opaque white and color pigments are included in this classification. The synthetic inorganic pigments are generally quite opaque, although certain types, like iron blue and ultramarine blue, yield strongly colored plastics of excellent transparency. Generally speaking, these pigments are highly resistant to light, heat, and migration, nonsubliming, and bleed resistant. They vary greatly in chemical resistance and in the effect they may have on the curing and stability of plastics compounds.

The titanium dioxide pigments are used where the highest opacity, tinting strength, and brightness combined with chemical inertness are required. They are characterized by excellent resistance to heat, light, migration, and chemical attack. These outstanding features make them the most universally adaptable and effective white pigments for nearly every type of plastic. There are two series of these pigments, rutile and anatase, which, though chemically identical, are different in structure of the crystals that make up the pigment particles. The rutile types are generally more inert than the anatase types. Despite their excellent general fastness properties, these pigments have the sometimes troublesome feature of being dulled in color brightness by strong reducing agents. They may turn grayish in certain amino plastics, especially when exposed to light. Sunlight or ultra-violet radiation greatly accelerates this discoloration. Some grades may promote the degradation of polyethylene and certain polyvinyl formulations, apparently acting catalytically, while others, particularly certain specially treated rutile types, give excellent stability in properly formulated compounds.

DYES are soluble in acetone, ketone, or di-octyl phthalate; they are solely organic.

PIGMENTS are organic, inorganic, or metallic, have little solubility, are mechanically incorporated in plastics.

The zinc sulfide pigments, both pure and reduced (lithopone), have good resistance to light, heat, and migration, but are more reactive than titanium dioxide and not completely resistant to acids. They are used in certain phenolic and urea-aldehyde plastics, but may promote degradation of polyvinyls. The zinc oxides have good resistance to heat, light, and migration. They are reactive chemically, tending to form soaps with organic acids, and may cause saponification of certain plasticizers at high temperatures. Zinc oxide may cause degradation of vinyl polymers.

The white lead pigments have good resistance to heat, migration, and light, but darken with sulfur fumes on weathering. These pigments are toxic and reactive chemically, and tend to stabilize polyvinyl compositions.

Antimony oxide has good fastness to heat, light, and migration. It finds its greatest usefulness in "flameproof" compositions, as it tends to retard burning. It is rarely used primarily for its pigmentary properties due to its low opacity and high cost.

The cadmium pigments are good to excellent in resistance to heat, light, and migration. Their chemical resistance is generally good, except to certain relatively strong acids at elevated temperatures.

The lead chromate pigments, including chrome yellows, molybdate oranges, and chrome oranges, have quite good resistance to heat and excellent non-migrating properties. They are moderately resistant to chemical attack, but are sensitive to alkalies and affected by some acids and reducing agents. They darken somewhat on exposure to light and weathering. They generally have a stabilizing action in polyvinyl plastics and are useful in polyethylenes.

The chrome greens (iron blue-chrome yellow combinations) have very good resistance to heat, light, and migration, little or no antioxidant effect, good stability to acids, but poor alkali resistance. They are useful in peroxide catalyzed plastics.

The chromium oxide greens are lightfast, durable, and resistant to heat, acids, alkalies, and reagents generally.

Inorganic blue pigments differ greatly among the chemical groups in resistance properties. The iron blue pigments have excellent resistance to heat, light, and acids, but are very sensitive to alkalies. They are also sensitive to strong reducing agents and may fade in pale tints under certain conditions of use. The ultramarine blues have good resistance to heat, light, alkalies and migration. Although quite sensitive

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Pressure per square inch on material at end of plunger	9,100 lb.
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Mold opens (adjustable)	6—9 in.
Maximum die space	7¼ in.
Minimum die space	3¼ in.
Maximum recommended casting area in mold	15 sq. in.
Size of die plates	16 x 10 in.

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to acids, they are widely used for coloring polyvinyl, polystyrene, urea- and melamine-aldehyde, and polyester plastics. Some of these blues, very green in tone, are sold as "cobalt blues." These should be distinguished carefully from the blue cobalt compounds commonly used in coloring ceramics.

The synthetic iron oxides (yellow, red, and black) have excellent durability and resistance to heat, light, migration, and chemicals. However, the yellow hydrated oxides are reddened by prolonged heating at elevated temperatures.

Aluminum powders have excellent resistance to heat, light, and migration but limited resistance to reagents, particularly acids.

Natural Inorganic Pigments

The natural inorganic (earth) pigments include the ochres, siennas, umbers, and synthetic and natural iron oxides. They have good to excellent durability and generally resemble the synthetic iron oxides in resistance characteristics. Often, however, they contain impurities that may induce degradation.

Dyes

As a group, dyes are characterized by wideness of color range, brightness, transparency, and solubility. The individual dyes differ greatly in all the properties that determine their suitability and adaptability for coloring plastics.

For a discussion of their properties of major importance in the coloring of plastics, dyes may be classified into the following groups:

1. Nigrosines and Indulines

These azine dyes, particularly the bases, hydrochlorides, and sulfonates of the nigrosines, are used in greater quantities than all the other dyes together in the plastics field. They have good heat, light (in full blacks), and aldehydes resistance. Certain of the dye bases are useful where dielectric effects are important, particularly in phenolic molding compounds and laminating varnishes. They have good chemical resistance but tend to inhibit peroxide catalyses. The hydrochlorides have many of the same resistance and solubility features, but are more soluble in alcohol. They must be used with caution in plastics affected by hydrochloric acid, because of their tendency to liberate acid at high temperatures. The sulphonates are water soluble (25%) and have moderate heat and light resistance.

2. Oil-Soluble and Acetate Dyes

These dyes are insoluble in water, but soluble in a wide range of nonaqueous liquids. They have good heat resistance, and many tend to soften and melt in the 95 to 140° C. range, making them easily dispersible in hot processing, although some may sublime. They have very good fastness to light in polystyrene, but are rather fugitive to light in many other plastics; they tend to effloresce and migrate from plasticized stocks; and they have moderate to very good resistances to aldehydes but strong antioxidant effects.

3. Acid, Chrome, Direct, Developed Dyes

These dyes are usually sodium salts of colorant acids. Of the hundreds available, only a limited number regularly are adaptable as colorants for plastics. They are suitable for coloring many water or spirit soluble binders and certain phenolics.

Color of an object depends on that portion of the spectrum present in each ray of light reflected by that object. A green plastic bowl will absorb red, orange, yellow, blue, and violet, and reflect to the eye the green with which it is colored.

4. Basic Dyes, Basic Dye Bases

Dyes of this group have good resistance to heat and aldehydes, but are quite fugitive to light. The dye salts tend to hydrolyze and split off acids, so their use should be avoided where this action may cause degradation of the plastic. Selected types are widely useful in phenolic plastics.

5. Vat Dyes

These dyes are soluble in alkaline reducing solutions, have very good resistance to heat and reagents, but vary greatly in lightfastness and bleeding characteristics. Helidon pink, Prototype 109 (1) is used for bright, clean, fluorescent pinks in thermoplastics.

Acknowledgments

The author gratefully acknowledges the editorial assistance of Mr. L. A. Melsheimer; the help given by Mr. F. J. Hines in gathering data; the several courtesies of Messrs. C. C. Addison, W. H. Hoback, H. G. Rotherham, D. H. Stubbs, of the Pigments Division; the help of Dr. Charles Maresh and Mr. R. Krammes of the Research Division in the preparation of illustrative material; the helpful suggestions of members of the Dyestuff Department of the Organic Chemicals Division; and the permission of American Cyanamid Co. to publish the data contained herein.

• • •

Nothing contained herein shall be construed to imply the non-existence of any relevant patents nor to constitute a permission, inducement, or recommendation to practice any invention covered by any patent owned by the American Cyanamid Company or by others without authority from the owner of the patent.

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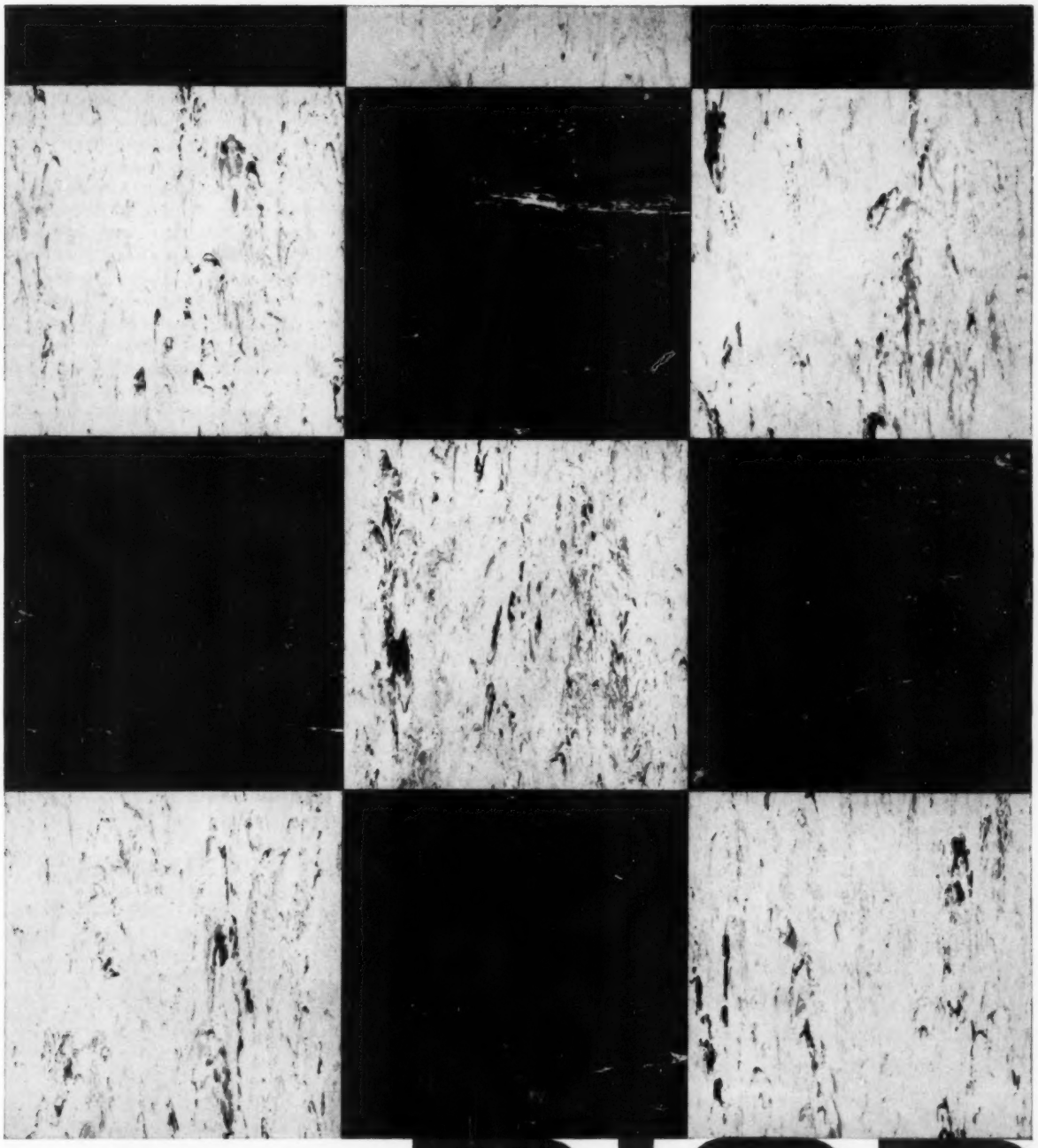

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Photo Enlargers

(*From page 91*)

at an angle, the bearing faces in the opening are similarly at an angle to the draw of the mold. To eliminate need for an expensive cam arrangement to mold this opening, a force plug representing one half of the aperture and consisting of one straight face and one oblique face, is located in each half of the mold. When the mold is closed, the two straight faces mate, and the opening is formed at an angle around the oblique faces.

Also in this rear half of the lens housing are two thin parallel wall sections into which a steel spring nests. The bottom half of this spring is the part that locks the lamp and lens housings together. The upper half of the spring is fitted with a molded styrene shoe. When the column support is inserted into the opening in this rear section, the molded shoe presses against it with sufficient pressure to hold it in place, but lightly enough to allow the user to slide the enlarging unit up and down on the column.

In the base of the housing proper, a lens barrel sleeve, injection molded separately of medium-impact styrene, is solvent-bonded into a molded-in recess. A piece of felt material with a pressure-sensitive backing is applied to the bottom half of this sleeve to prevent contact between the sleeve and the lens barrel which is later inserted into it. Eight flexible "fingers" projecting upwards from the sleeve are designed to apply uniform and sensitive pressure to the lens barrel as it is twisted in and out while the enlarger is being focused.

Lens Barrel

The lens barrel is molded of medium-impact styrene in the same combination mold as the sleeve. An opening, which serves as the fixed diaphragm, is molded into the exact center of the barrel. Molded-in lens seats are also provided on both sides of the diaphragm to receive the pair of lenses used. To install these lenses, a set of styrene retaining rings is cemented into the interior of the seats and the lenses are bonded to the rings. The interior of the barrel incorporates a step design that functions to keep light reflection to a minimum.

All of the smaller plastics parts of the enlarger—including the film carrier, column cap, and retaining rings—are molded of high-impact styrene in a family mold.

The new enlarger will make all standard size enlargements for all negative sizes up to and including 2¼ by 3¼ inches. The swivel column support enables outsize enlargements to be made off the baseboard when the enlarger is rotated 180 degrees, permitting the picture image to be projected below the level of the baseboard.

The all-plastics photo enlarger has been enthusiastically received. Dealers and end-users alike have been impressed by its advantages . . . and it is felt that because the enlarger is so inexpensive, eye-appealing, and easy-to-use, it will do much to promote photography as a hobby that everyone can enjoy.

CREDITS: The Enlarger Model No. 7 is marketed by The FR Corp., New York, N. Y. Lens barrel sleeve, lens barrel, and minor plastics components are molded by The FR Corp., using styrene supplied by Monsanto Chemical Co. The lamp housing is molded by Boonton Molding Co., Boonton, N. J.

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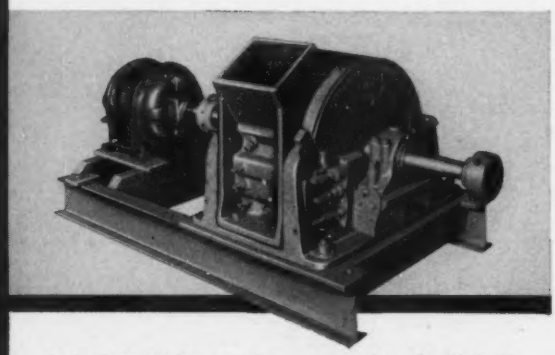

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82

Adhesion

(*From page* 116)

tack temperature is at its lowest point).

The adhesion of polymers to cellulose is probably polar-group specific. If the surface of the cellulose is modified by treatment with Werner-chromium complexes of organic acids with polar group substituents, the adhesion of polymers is changed. With a stearic acid complex the cellulose becomes actually polymer repellant. By choosing acids with polar groups like those in the polymer, e.g., CN, adhesion is promoted to a high degree, e.g., four to six times the adhesion to untreated cellulose. These effects and several of those described above show that specific factors involving polarity of the surface and of the polymers are of paramount importance in adhesion in these systems. The fact that adhesion varies from very high to very low values with closely related polymers or with slightly modified cellophane shows the minor role of "mechanical" bonding.

The author wishes to acknowledge the helpful collaboration of Dr. C. H. Hofrichter, Jr. in obtaining some of the data, and for his part in the development of the theory of the adhesion problem here discussed.

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THE PLASTISCOPE*

NEWS AND INTERPRETATIONS OF THE NEWS

By R. L. Van Boskirk

Carbide's New Plasticizers

FOR several years it has been said by various experienced authorities that future progress in the vinyl field would be limited until someone produced a general-purpose plasticizer that would be better than D.O.P. at the same or lower cost. D.O.P. is a high-standard plasticizer by which others are measured, but an even better one would be welcomed. Now comes Carbide & Carbon Chemicals Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y., with two new phthalate plasticizers which they assert are at least equal to D.O.P. in every respect and better in some. The price is 32¢ in tank car lots—the same as D.O.P.

The two new materials are called Flexol 810 and Flexol 812. They are made from higher alcohols produced from hydrocarbons in Carbide plants. The company will not yet divulge which particular alcohols are being used but state that the supply of raw material from which Flexol 812 is made is unlimited and that from which Flexol 810 is made is plentiful enough to make possible limited tank car shipments of the plasticizer right now, and that it will be even more plentiful after the early part of the coming year.

The characteristics of the new Carbide phthalate plasticizers are described as follows: exceptionally low volatility, improved low-temperature properties, exceptionally good electrical properties, unusual resistance to extraction by water, outstanding heat and light stability, complete compatibility with vinyl chloride resins, substantially odorless, low order of toxicity, good efficiency, resistance to rub-off from upholstery sheeting, and color less than 50 platinum cobalt. It is also stated that they will help produce plastisols having stable viscosities.

Flexols 810 and 812 are the type of plasticizers that can be used for practically every kind of vinyl chloride product and can generally be used as the sole plasticizer in most compounds. This means that they can be used for film, sheeting, electrical insulation, profile extrusions, cloth coatings, slush-molded articles, flooring, and plastisols for dip coating.

Carbide officials indicate that these two new Flexols are the forerunners of a whole new line of plasticizers that will be introduced by that company from time to time in the not too distant future.

Future for Mylar

IF THE enthusiasm shown over the appearance and performance of Mylar polyester film at a recent public exhibition of the material is any criterion, the film is certainly due for wide acceptance by the American public.

Some 20 or more end products made from Mylar were exhibited at the show, which was put on by Du Pont in New York City. Major emphasis was placed on electrical applications which up to now have absorbed the largest share of the material. Mylar is used primarily for insulation purposes, especially in capacitors and motors where a thin film of Mylar can be used to replace much thicker insulation and thus help to reduce the size of electrical equipment. However, even as good as this application seems to be, there is still some doubt as to just how fast it will grow. Some electric motor manufacturers will have to retool to take full advantage of Mylar, although several are already using the material for this purpose.

Most of the applications shown at the Du Pont exhibit have already been discussed in MODERN PLASTICS (see "The Future for Mylar," *30*, 226, Nov. 1952 and "Mylar Polyester Film Soon to be Available in Quantity," *31*, 210, May, 1954). The one particular eye-filling item not mentioned previously was a film of metalized Mylar laminated to leather which is used for ladies' formal dress shoes that retail at perhaps $20.00.

The packaging people find it most difficult to keep from becoming over-enthusiastic about the possibilities of this attractive, tough film. Their eyes glisten and their mouths water whenever they look at it. But Du Pont has always indicated that it does not expect tremendous volume in this field for various reasons. One of them is cost. The current price of the material is from $3 to $4 a lb., although of course that price will be adjusted when production becomes big volume. Another reason is that the film is difficult to seal, although a welding process has been perfected.

Of course, Mylar could be used in packaging applications in thicknesses of ½ mil or less and thus reduce cost, but film which is that thin would be almost impossible to handle on any known packaging machine. On the other hand, Du Pont officials point out that there are quite likely to be specialty packaging uses for which Mylar will be used in reasonable quantities. Such applications would include packages for products with sharp corners; packages that require an extra strong film; packages that contain an extremely high quality product; and packages that must protect their contents from moisture. It might be that even such things as high-grade sheets and other soft goods will eventually come to market in Mylar film.

Company officials do not seem to believe that Mylar will ever cut into the polyethylene or cellophane field to any noticeable extent. In other words, markets will be developed for Mylar that are not commonly served by any other type of film.

Mylar may compete with acetate film to some extent in such applications as insulation tape and sound recording tape. In the latter case, it would be primarily used for film that has to be used many, many times. However, acetate material would continue to go into sound tapes that are to be used only a few times.

Even though mentioned before, it is probably worthwhile to point out again that Mylar polyester film

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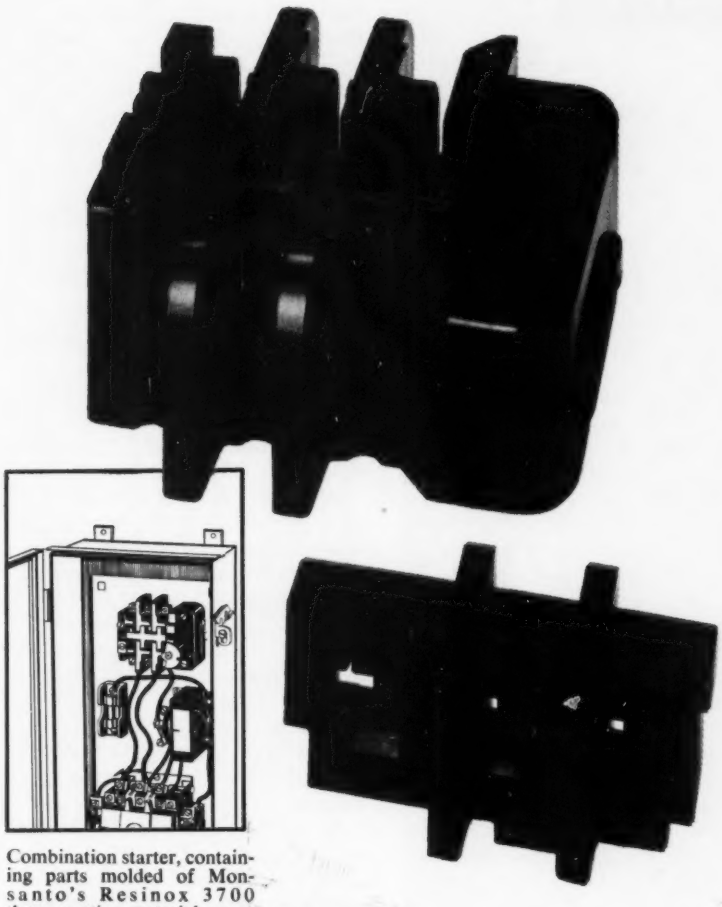
How would you handle this electrical parts problem?



Combination starter, containing parts molded of Monsanto's Resinox 3700 thermosetting material, manufactured by Arrow-Hart & Hegeman Electrical Co.

Arrow-Hart solved it with new RESINOX 3700

Arrow-Hart & Hegeman Electrical Company of Hartford, Conn. needed a strong, stable, electrical-grade material with high arc-resistance for important parts of their combination starter shown here. They specified Monsanto's new thermosetting molding powder, Resinox 3700. Result: Complete satisfaction!

Resinox 3700 is the ideal all-around material for magneto ignition, motor control and electronic circuits, and other electrical applications.

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properties are most unusual. The tensile strength of the material is 23,500 p.s.i., about ⅓ that of machine steel; its dielectric strength is greater than almost any known insulating material; its impact strength is at least twice that of any known commercial film; and its dimensional stability is such that it remains flexible and stable from —140 to 302° F. or over. Mylar is chemically inert, has a high degree of impermeability to water vapor, resists the passage of odors, and can be sewn with standard sewing threads. It will burn, but less readily than will other films such as cellophane and acetate.

The new $10 million Du Pont plant for production of Mylar polyester film is scheduled to come into production at Circleville, Ohio, sometime in July or August.

New Black for Plastics

CARBON black which is economically priced and has wide application in the plastics field has been announced by Binney & Smith, Inc., 380 Madison Ave., New York, N.Y., distributors of Columbian Carbon Co. products.

The product, sold under the trade name No. 999, is claimed to produce good jetness and can be used with many plastics, including the phenolics, vinyls, polystyrene, and polyethylene types. Particles size is listed as 19 and blackness index as 175. Ultra-violet screening is high and one of No. 999's important features is its ability to impart good weathering qualities to polyethylene cable and extruded pipe.

Samples may be obtained from Binney & Smith.

Polyester Laminate

SUBSTANTIAL production economies and greater ease of operation in electrical insulation are claimed to be made possible by the development of a new industrial laminate by Continental Can Co., 100 E. 42nd St., New York 17, N.Y.

Designated as Conolite EPNXXP, the material is reported to have two outstanding exclusive features: 1) It comes in rolls of continuous lengths, allowing for uninterrupted operation of parts stamping machinery over longer periods of time. 2) It has a glossy, white, opaque finish, which can be effectively printed upon or embossed in black or colored lettering.

The new material is available in thicknesses ranging from 0.025 to 0.062 inch. Rolls come 36 in. wide, and in lengths up to 150 feet. The rolled flexibility of Conolite EPNXXP makes for convenience in handling large quantities and also for fitting the laminate to sizable curved surfaces.

A paper-base lamination using polyester resin, the new material is readily fabricated, cut, drilled, or cold-punched automatically without chipping or fracturing. No special tooling is required.

The physical and electrical properties of the laminate are comparable to N.E.M.A. standards and have been accepted by the Underwriters' Laboratories.

Sale of the material is handled through Continental. Its Conolite sales office is located in Wilmington, Del.

Polyester Business

MORE than 40 companies are now reported as producers of polyester resin for reinforced plastics. The latest to make an official announcement was U. S. Industrial Chemicals Co., Div. of National Distillers Products Corp. The plastics industry was aware that the new resin had been on trial in various plants for several months, but the usual precaution against premature announcement before the resin had received thorough trial was taken before the company would permit official announcement.

Just as this magazine is going to press, word comes that Archer-Daniels-Midland Co., Minneapolis, Minn., has purchased the resin plants, formulations, and trademarks of U.S.I.

U. S. Industrial has been in the surface coating business for years and was one of the pioneers in the development of synthetic resins for the coating and allied industries. Under the new set-up, these synthetic resins, including polyesters, will be produced at Newark, N.J., Minneapolis, Minn., Los Angeles, Calif., and Pensacola, Fla., in the United States, as well as in Toronto, Canada, thus adding several plants to the former U.S.I. arrangement.

The new line of polyesters for use with fibrous glass or other reinforcement materials offers a wide variety of use. The tradename is Aropol with a numerical suffix to identify its use.

Aropol 7100 is formulated specifically for matched die molding with a fast cure. With a cure temperature of 250° F., a 0.050 to 0.070 in. thick laminate will cure in 1 to 2 min.; a 0.100- to 0.130-in. thickness will cure in 2 to 3 minutes. The styrene content is 25%, but up to 15 parts per 100 parts of resin may be added to reduce cost or adjust viscosity. A light-stabilized modification is designated Aropol 7100 LS.

Aropol 7110 exhibits exceptional chemical resistance suggesting its use in fume ducts and chemical tanks. It is intended primarily for general molding and hand lay-up. Aropol 7110 LS is light-stabilized and recommended for corrugated sheeting.

Aropol 7200 is a clear, self-extinguishing resin and can also be used in matched die moldings where retention of strength under high temperature is required. The addition of 5% antimony oxide will render the resin fire resistant. The light-stable Aropol A-7200 LS can then be used to make self-extinguishing corrugated sheet.

Aropol 7300 is a permanently flexible resin rarely used alone. It will impart flexibility and toughness to rigid resins and make them more resistant to shock and impact when proper filters are used.

CR-39 for Glass Replacement

FROM tiny windows on small instruments to cab enclosures for monster cranes is the recent history of applications for Homalite CR-39, a clear, transparent, scratch- and abrasion-resistant material with high optical and mechanical properties not generally available in glass. Its high tensile strength and resistance to weathering make this material most desirable in heavy-duty jobs. Because of its break resistance and because it is a better thermal

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insulator than glass, it is particularly useful for instruments. Since it is many times more break-resistant than glass, it is suggested as protective guard material for grinding wheels and as glazing for school houses. Its resistance to shock is many times that of plate glass and it is also insoluble in all known solvents, which makes it desirable around chemical plants.

CR-39 is a thermosetting plastic that exhibits better mechanical and optical stability at moderately high temperatures than thermoplastic materials and does not become brittle at low temperatures. It may be machined by almost any method with which it is possible to machine metal and has good light piping and edge lighting qualities.

The product accepts permanent printing by a process developed specifically for CR-39 and which offers economy over the standard practice of engrave and fill.

Informative Bulletin 1052 and a free sample is available from The Homalite Corp., 14 Brookside Dr., Wilmington, Del.

Teflon Prices

A SCHEDULE of reduced prices for Teflon has been announced by Du Pont. Reductions in prices for large containers of Teflon range from 40¢ a lb. for molding powders to $1.00 a lb. for dispersion resins. Fine Teflon powder for extrusion of tape and wire coatings was reduced 50¢ a lb. for any quantity.

Melamine-Polyester

BONDED with a polyester-modified melamine resin, a new paper-base electrical grade laminate has been developed to eliminate the difficult machining properties frequently encountered with the present series of melamine plastics.

Developed by National Vulcanized Fibre Co., Wilmington, Del., the new high-pressure laminate is said to possess excellent dielectric strength, low dissipation factor, and and good moisture resistance. In its arc resistance, the new material, designated Phenolite Grade Y-2401, lies approximately midway between paper-base phenolic (Nema Grade XXX) and paper-base melamine (Nema Grade XX-M). Chief advantages to the electrical industry are that the new laminate has much superior arc resistance, dielectric strength, dissipation factor, and moisture resistance, compared with the electrical grades of the phenolics (such as Grade XXX). In addition, it is just as easy to machine as the paper-base phenolics.

The melamine-polyester material is intended for such electrical applications as transformers, television and radar insulation, circuit breakers, switch bases, and supports for sliding contacts—in fact, wherever good electrical and arc-resisting properties are required. In the past, because of machining problems, it was sometimes necessary to fabricate these components from phenolic laminates in preference to the melamines. Now, such parts can be made from the modified melamine; but owing to superior arc resistance of the new material, the parts can be reduced in size while providing the same electrical properties.

Naugatuck Expansion

WITH new production facilities soon to be completed and a number of new products scheduled to move from laboratories into production, there is a good chance that Naugatuck Chemical will increase its sales volume 25% by 1956. This was stated at a press conference observing the 50th anniversary of Naugatuck Chemical Div., United States Rubber Co., Rockefeller Plaza, New York 20, N.Y. It was also stated that Naugatuck is now responsible for production valued at over $100 million each year—125% larger than 1946.

The current expansion program will add about 50 million lb. of nitrile rubber, plastics, and agricultural chemical production to the division's annual capacity before the end of the year.

Naugatuck is currently doubling production of Marvinol vinyl resins in its Painsville, Ohio, plant; tripling Kralastic molding powder production in its Baton Rouge, La., plant; constructing additional agricultural chemical production facilities in its Naugatuck, Conn., plant; and expanding its latex plant in Los Angeles, Calif.

Plastics in Education

INTERPRETING industrial plastics processes and materials in schools was the subject of a session of the National Education Asscciation of the United States at its recent meeting in New York City.

The speaker was Dr. Robert Lloyd Cantor who stated that the reason for dealing with plastics at a meeting of educators was because of their general impact on our technological society.

Kel-F Price Reduction

PRICE reductions of Kel-F recently announced by The M. W. Kellogg Co. mark the fourth major price cut since Kel-F polymer was introduced commercially in 1948.

The greatest reduction, 42%, was made on high density Kel-F molding powder in small lots. In amounts of 1 to 99 lb., the new price is $10 a lb., compared with the old price of $17.45; 100 to 1999 lb., $9.50 a lb.; and 2000 lb. and more, $9 a pound.

Other price changes were: low density Kel-F molding powder—1 to 99 lb., $9.50 a lb.; 100 to 1999 lbs., $9 a lb.; and 2000 lb. and more, $8.50 a pound.

Plasticized molding powder—1 to 99 lb., $11 a lb.; 100 to 1999 lb., $10.50 a lb.; and 2000 lb. and more, $10 a pound.

Kel-F dispersion was reduced from $15 to $12 a lb., solids content.

New High Gloss Sheet

DEVELOPMENT of a process for producing a high gloss surface on rigid sheets of extruded polystyrene has been announced by Auburn Button Works, Auburn, N.Y. The company claims that this development overcomes a stubborn problem that until now has cancelled the other virtues of the plastic as a material for many products now using sheet metal, fused porcelain, baked enamel, vitreous finish, or glossy paint.

The new shiny sheet, called Chinatex because of its porcelain-like sheen, can be inexpensively molded by the vacuum-forming

process without losing its luster. The material is available to manufacturers and molders at no extra cost over standard sheet. First uses of Chinatex will be for the interior walls of refrigerators, freezer panels, automobile parts, television picture tube masks, display forms for apparel, three-dimensional advertising signs, kitchen utensils, toys, and novelty merchandise.

Auburn reports that the best surface obtainable on extruded sheet up to the present time has been an egg shell texture. The new Chinatex presents a brilliant enamel-like finish that can be easily cleaned. One side has the new glossy finish, while the other side has the standard egg shell surface. It is available in all colors and white.

The material is now being extruded in any length in thicknesses up to ¼ in. and widths up to 40 inches.

The new glossy tinted sheet may be vacuum-formed for use as housings for business machines and similar products which now require expensive dies and a separate finishing process. The glazed sheet should prove practical as a wall tile for kitchens, bathrooms, shower stalls, and as a tough covering for table tops.

Chinatex is chemically inert to practically all acids and alkalies, water repellent, and will not mildew or rot.

The company states that it is looking forward to the production of thicker gages and greater widths of the colorful sheet, which is expected to lead to larger products such as outer cabinets of refrigerators, washers, driers, and kitchen equipment.

Monsanto's Isocyanate

JOINTLY owned by Monsanto Chemical Co., St. Louis 4, Mo., and Farbenfabriken Bayer, A. G., Leverkusen, Germany, the newly formed Mobay Chemical Co. has been incorporated in Wilmington, Del., for the manufacture of isocyanate compounds.

David L. Eynon has been elected president of Mobay. Directors of the company are Mr. Eynon, John L. Gillis, Dr. Oskar Loehr, Edward M. Pflueger, and J. Russell Wilson.

Until recently, Mr. Eynon has been assistant to a vice president of Monsanto in St. Louis. He joined the company in 1933 and has served in research, production, and executive administrative positions since that time. Mr. Gillis is vice president in charge of marketing of Monsanto and Mr. Wilson, vice president and general manager of the Research and Engineering Div. Mr. Loehr is a member of the *Vorstand* (executive committee) of Farbenfabriken Bayer. Mr. Pflueger is president of Naftone Co., New York, N.Y., a trading and importing company.

Temporary headquarters of Mobay are with Monsanto at St. Louis. No decision has been made as to the size or location of the isocyanate plant.

Non-Metallic Stabilizer

DEVELOPMENT of a non-metallic complex organic compound, main function of which is to increase heat and light stability of vinyl compounds, has been announced by Advance Solvents & Chemical Corp., 245 Fifth Ave., New York 16, N.Y.

Called Stabilizer E-49, the material also prevents initial yellowing as well as the yellowing which usually develops on prolonged processing on the calender at elevated temperatures. Though it can be used as a stabilizer by itself where extreme heat stability is not required, the company recommends its use in combination with a metallic stabilizer to give maximum heat and light stability.

Canadian Vinyl Converter

NEW entrant into the vinyl film converting field is Canadian Resins and Chemicals Ltd., 600 Dorchester St. W., Montreal 2, Que. A new printing and embossing plant, containing up-to-date printing and deep-embossing equipment, has now been completed at Ste. Therese, Que., and operations are scheduled to start in July.

Canadian Resins will print and emboss its own vinyl film which is produced at Shawinigan Falls, Que. It will convert film only, not sheeting. The company reports that the film will provide Canadian fabricators with modern, decorative prints having texture-like finishes.

Exclusive Canadian rights to Toscony print patterns have been obtained by Canadian Resins. For the first time, the complete line of over 700 patterns will be available from a Canadian source on Canadian vinyl film. Canadian Resins will continue to maintain its rigid quality control on 3- and 4-gage thicknesses, thus ensuring satisfactory performance in consumer products made up from its printed goods.

Reinforced Plastics Council

ABOUT a dozen firms in the Delaware River Valley, which manufacture laminated sheet and moldings of reinforced plastics, have formed an industry advisory group to be known as the Delaware Valley Reinforced Plastics Council.

The Council has as its objectives: a) the dissemination of knowledge of the characteristics and potentialities of reinforced plastics; and b) providing technical assistance to design and engineering groups interested in reinforced plastics applications.

The first exhibit of the Council was held at the Bellevue-Stratford on April 21, in conjunction with the regular weekly Philadelphia Rotary Club luncheon on that date.

Information is available by writing the Council at P. O. Box 4245, Philadelphia 44, Pa.

Vinyl Lampshades

EMBOSSED vinyl lampshade material of a different type than that generally seen on the market is announced by Fabritate, Cedar Grove, N. J. Company officials claim that they are using a new embossing process that gives a deep and lasting effect and produces lampshade material that permits even flow of light.

The embossed sheets produced by Fabritate are 15 mils thick and come in 20 different patterns and colors with floral, geometric, and other popular lampshade designs. The material is also suggested for screens, wall covering, auto kick plates, and wherever a rigid, decorative panel-type material is required.

Upholstery by Goodall

DEVELOPMENT of a new 25-oz. knit-backed vinyl upholstery, called Elastic Goodallite, has been announced by Goodall Fabrics, Inc., a subsidiary of Goodall-Sanford, Inc., 525 Madison Ave., New York, N.Y.

The company reports that the new material, priced at $1.67 a yd. in a 52 in. width, offers the advantages of heavier knit-back coverings at a

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price considerably lower than anything comparable now on the market.

A burnished antique finish gives the fabric a leather-like appearance. It is available in six colors—red, green, lime, brown, grey, and saddle tan.

Goodall reports that tests of Elastic Goodallite in furniture manufacturing have proved highly successful on deep-spring upholstery. The fabric is easy to work with and its knit-backed construction, usually found only in heavier materials, makes for easier handling and consequent labor savings when compared with supported-type vinyl upholstery.

Polyethylene Compounds

DEVELOPMENT of compounds based on Bakelite polyethylene resins, designed for special applications that require only certain of the usual polyethylene properties, has been announced by Bakelite Co., a Div. of Union Carbide and Carbon Corp., 260 Madison Ave., New York 16, N.Y.

These compounds were developed by L. A. Dreyfus Co., South Plainfield, N.J., with the cooperation of Bakelite. Known as Ladcote compounds, they are designed primarily for extrusion coating of packaging materials such as paper, board, foil, and film.

One of the Ladcote compounds, a blend of polyethylene with 40% by weight of wax, is applied to kraft paper by Lowe Paper Co., Ridgefield, N.J. This coated paper has a high order of resistance to water vapor transmission, lower cost, lower heat-sealing temperatures, higher gloss surface, and improved release of packaged materials. However, paper thus coated has less elasticity and resistance to grease, scuffing, and abrasion than paper coated with straight polyethylene.

Multiwall bags costing about 4% less than bags made of straight polyethylene-coated paper is one of the uses for the new product. These papers are designed for packing such things as nitrate fertilizers, cements, resins, quick-lime, powdered milk, brown sugar, bread, and non-fat frozen foods. The compound-coated paper is also used for lining bottoms and walls of fiber drums in which chemicals are shipped.

Extrusion-laminated between two fibrous sheets, one combination of Bakelite polyethylene and wax acts as both an adhesive and an interply barrier. It does not interfere with conventional gluing and handling of paper and board products such as folding cartons, set-up boxes, textile wraps, and multiwall bag linings. The sandwich-type sheet is also recommended for wrapping such materials as blueprint papers which are sensitive to both light and moisture.

The combined economy and effectiveness of this coating compound suggest possible uses on foil, film and paper pouches, and packages holding liquid or dehydrated foods, sauces, and beverages; on both woven and non-woven textiles, from nursing mothers' pads to shipping tarpaulins; and on paper and board to package both moist and moisture-sensitive products.

Plastic-Tungsten Surfacing

CALLED Tungstide, an entirely new kind of metal surface cladding which can be applied at room temperatures and which not only imparts to the base a hardness and abrasion-resistance almost equal to metallic tungsten, but which is self-lubricating as well, has been announced by The Lockrey Co., Southampton, N.Y.

The material is reported to be a suspension of particles of tungsten of near-colloidal particle size in an unnamed plastic. Incorporated in the mixture is a hardening form of the company's Liqui-Moly which provides dry, clean, built-in lubrication.

The company claims that Tungstide is now being tested in such applications as reducing the wear and extending the life of relay-latching members in electronic computers; for surface-hardening and preventing dimensional losses by stylus-wear on cast phenolic masters in duplicating machines; eliminating grease lubrication and wear in bomb fuses; and in applications where a case-hardening effect is desired on brass, plastics, and other softer materials.

Tungstide coatings are expected to find wide use in the automotive and aircraft fields for sheet metal forming molds and tools; for reducing wear on plastic drilling, assembly, and checking jigs; for replacing metal inserts formerly placed over wear spots on plastic molds and tools; to reduce wear on vacuum-forming molds; and on plastic parts which must take considerable sliding wear in service.

The new coating, available in pint and gallon quantities, may be applied by brush, dip, or spray.

P.P.M.A. Committees

CHAIRMEN for the following committees of the Proprietary Plastics Manufacturers Association, 5719 W. Chicago Ave., Chicago 51, Ill., have been appointed, according to an announcement by Richard A. Winter, president of the association:

Standards Committee: J. M. Jayne, vice president of The Plas-Tex Corp.

Ethics Committee: Harris Brin, vice president of Loma Plastics, Inc.

Public Relations Committee: D. L. Jocelyn, president of Plastray Corp.

Accounting and Finance Committee: David D. Lovitz, sales manager of Bernard Edward Co.

Codes Committee: D. S. Poulton, sales manager of Columbus Plastics Products, Inc.

Membership Committee: J. B. Mockenhaupt, sales manager of Victory Mfg. Co., Chicago, Ill.

Traffic Committee: J. L. Sholkin, president of Beacon Plastics Corp.

Teflon Coater

REORGANIZATION of the setup at Electric Furnace Corp. has resulted in the creation of Livingstone Coating Corp., 709 W. Third St., Charlotte, N.C. Electric Furnace, one of the pioneer coating companies specializing in the application of Teflon, started operations in Chattanooga, Tenn., in 1951. The branch in Charlotte will concentrate on increasing its Teflon coating program but will also use other plastics coatings particularly suitable for protection against corrosion.

According to a Livingstone spokesman, the company will pay particular attention to Teflon appli-

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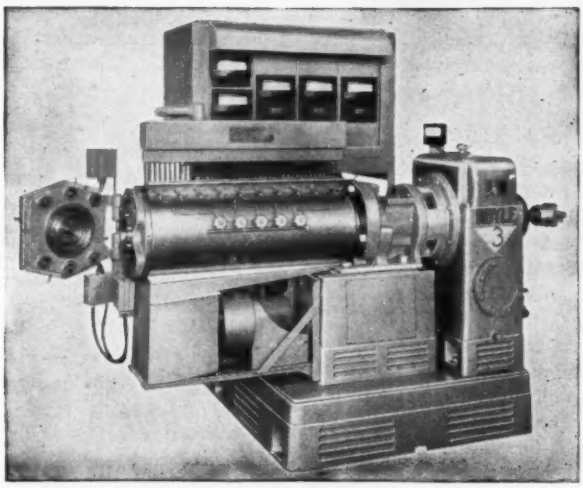

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cations for textile mills and other industries where the material has proved useful in preventing adhesion and build-up of sizing solutions on slasher cylinders, wet split rods, size boxes, etc. New applications for Teflon and other plastics that prevent corrosion are proving most effective for air conditioning equipment, overhead cleaning system fans, exhaust louvers, and chemical storage tanks.

J. S. Livingstone, vice president of Electric Furnace Corp., is now president and treasurer of Livingstone; D. F. White, vice president; and Mrs. B. J. Livingstone, secretary. Mr. White is sales manager of Midland Wire Corp., Birmingham, Ala.

Rubber and Plastics

IT IS no longer practical to think of rubber and plastics as two different classes of materials," says Roland Reppert, vice president of American Hard Rubber Co., 93 Worth St., New York 13, N.Y. "In fact, it has often been said that hard rubber . . . a true thermosetting plastic . . . was the first, the forerunner of plastics and rubber-plastics blends as we know them now. When considering materials for any specific application today, it is invariably necessary to compare many different plastics . . . including hard rubber . . . and to make the choice on the cold, hard facts of cost, life expectancy, and technical properties."

This statement was made by Mr. Reppert at the time a merger between the Chemical Equipment and Plastics Divs. of the company was announced. Products of the new consolidated division will include eight different types of Ace hard rubber and plastics pipe and fittings, ranging from rubber-lined steel to a new high-impact styrene blend which will be announced soon.

George H. Reed, formerly manager of the Plastics Div., is now in charge of the combined hard rubber and plastics operations. Mr. Reed joined the company in 1934, and after three years in laboratory and manufacturing operations, became a field engineer for the Chemical Equipment Div. He was transferred to the Plastics Div. in 1947.

Connectors

INSULATING material, designated as Diall 51-01 and designed to be used as insulation for a new line of plugs, was introduced at the New York Radio Engineering Show by Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif.

The material is a thermosetting molding compound, having diallyl phthalate as its principal resin and asbestos as its principal filler. It is currently being used for inserts in connectors, solenoid parts, etc.

The company claims that the main advantages of Diall 51-01 are its higher dimensional stability (0.00041 to 0.00101 in./in. lifetime shrinkage), higher heat resistance (400 to 450° F. continuous exposure), better resistance against cracking during soldering operations, and higher impact strength (0.6 ft. lb./in. notch Izod).

Diall 51-01 was jointly developed by Cannon and Mesa Plastics, Los Angeles, Calif.

Pipetite for Pipe

A SEALING compound in stick form produced by Lake Chemical Co., 3052 W. Carroll Ave., Chicago 12, Ill., is recommended for use on plastics pipe, joints, and fittings.

The company claims that the product, called Pipetite-Stik, will not attack the plastics materials and will withstand pressures up to 5000 p.s.i.

EXPANSION

Witco Chemical Co., Ltd., Bush House, London, England, has entered the manufacturing field through the acquisition of a factory and technical research laboratory at Droitwich, Worcestershire, England.

The factory comprises a modern industrial plant in Union Lane. At the outset, the plant is manufacturing synthetic latex compounds for use in the production of latex-base paints. Ultimately, the new plant will produce the same chemicals as now manufactured in the United States by Witco Chemical Co., 260 Madison Ave., New York 16, N. Y., for the rubber, paint, printing ink, plastics, paper, and grease industries.

The Droitwich operation is under direct control of Witco Chemical Co., Ltd. and production activities are supervised by D. Roberts and J. McHugh.

F. J. Stokes Machine Co., Inc., 5500 Tabor Rd., Philadelphia 20, Pa., has launched a $1 million expansion program that will enlarge its production facilities by another 40 percent. The new program follows closely an expansion of about the same scale which was completed early in 1951.

Ground will be broken on July 4 for a 50,000-sq. ft. addition to the present Stokes' plant, which will provide additional manufacturing space and larger office and engineering department accommodations.

Durez Plastics & Chemicals, Inc., Walck Rd., N. Tonawanda, N. Y., announces that a new building has been started at its present plant. The $100,000 addition (exclusive of equipment), which will cover a floor area of about 4700 sq. ft., will house the company's new pilot plant.

The new unit will be equipped for piloting new chemical processes and materials developed in the company's research laboratories toward future full-scale plant production. Construction of the building is expected to be completed by the end of August of this year.

General Electric Co. announces the completion of the first phase of its plastics expansion program. Approximately 5000 sq. ft. of office space and toolmaking facilities have been added to G-E's Taunton, Mass., plastics plant. J. L. McMurphy, general manager of the company's Plastics Dept. in Pittsfield, Mass., states that the addition of 17,000 sq. ft. of manufacturing and warehousing space at the Plastics Dept.'s Decatur, Ill., plant should be completed by July 1954. He says that the expansion of both operations would provide G-E with what is believed to be the largest plastics custom molding facilities in the nation.

Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y., announces the completion of its ammonia production facilities at the new nitrogen plant in Omaha, Neb.;

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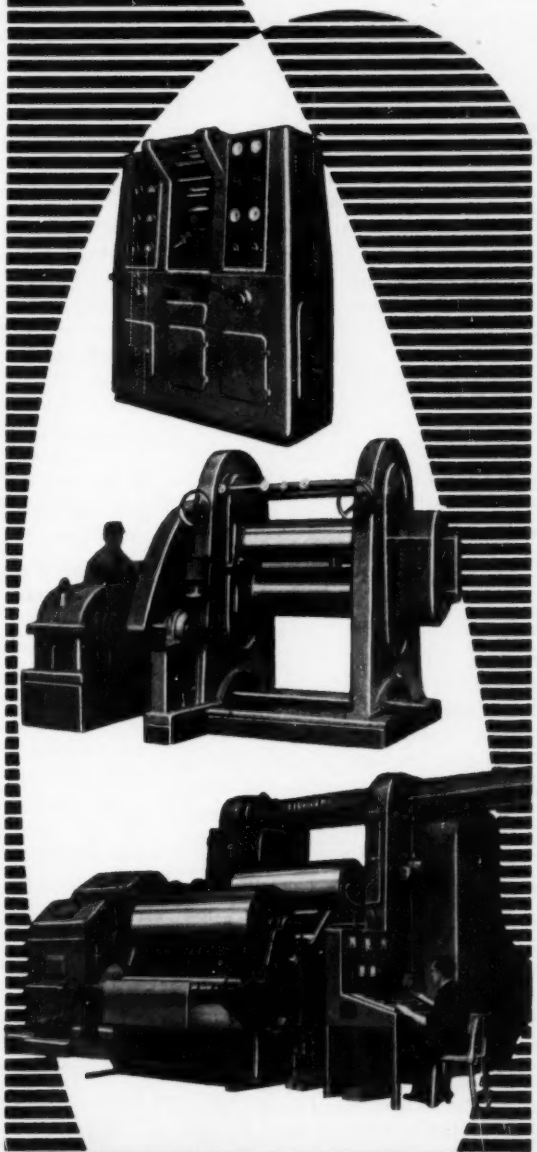

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it also reports that early completion of urea production facilities is expected. When finished, Allied estimates that the plant will cost upwards of $25 million.

McCoy, Jones & Co., Div. of General American Transportation Corp., 135 S. LaSalle St., Chicago 90, Ill., has completed an expansion program which has doubled and diversified manufacturing facilities. The company claims that it can now do every kind of work on plastics film.

New equipment has been added for electronic sewing and for use of dies in forming products. Machinery which will seal flat seams by combination of solvent, heat, and pressure has also been included.

COMPANY NOTES

Olin Industries, Inc., 570 Lexington Ave., New York, N. Y., and **Mathieson Chemical Corp.,** 745 Fifth Ave., New York, N. Y., have announced a proposal to merge the two companies.

The name of the new company will be **Olin Mathieson Chemical Corp.** Following the merger, **John M. Olin** will become chairman of the board of Olin Mathieson and **Thomas S. Nichols,** president. **John W. Hanes** will be chairman of the Finance Committee. Based on the 1953 figure, the combined corporation will have total assets of about $500 million and sales of over $500 million, including sales of non-consolidated subsidiaries and licensees.

At this time, Mathieson does not produce plastics raw materials, but plans to produce several resins at some time in the future. Olin produces polyethylene film, cellophane, and many other products.

The Watson-Stillman Co., Div. of H. K. Porter Co, Inc., Roselle, N. J., has organized sales, service, and manufacturing facilities in Europe through a wholly owned subsidiary, **Watson-Stillman Internationale Maatschappij, N. V.,** Groothandelsgebouwen Bldg., Rotterdam, Netherlands. Manufacturing facilities have been established with **N. V. Machinefabriek Breda,** formerly known as Backer en Rueb, Breda, Netherlands. Breda will manufacture a complete line of Watson-Stillman hydraulic machinery for the plastics, metalworking, extrusion, railroad, and general industries.

Officers of the new company are: **T. M. Evans,** president; **C. R. Dobson,** executive vice president; **A. B. Diss,** vice president; **J. C. Leslie,** treasurer; and **R. A. York,** manager. Messrs. Evans, Dobson, and Leslie hold the same posts with H. K. Porter in Roselle, N. J.

General Electric Co.'s Plastics Dept., Pittsfield, Mass., has formed an operations research section within its own management group and has appointed **K. O. William Sandberg** as manager of operations research.

J. L. McMurphy, general manager of the department, states that techniques employed by the new section will include analysis, projection, and prediction, so as to ascertain the best methods of approach to business problems.

Koppers Co., Inc., Pittsburgh 19, Pa., announces the following changes in personnel in its Research Dept.: **Dr. T. E. Robbins** has been named assistant manager, Laboratory Section, to succeed Dr. B. F. Daubert, who has resigned; **R. S. Detrick** is now assistant manager of the laboratory branch at the company's research center in Verona, Pa.; and **Dr. H. E. Tiefenthal** will replace Dr. Robbins as group leader.

Clearfield Plastics, Inc., Clearfield, Pa., formerly known as Americana Enterprises, Stamford, Conn., has opened a new plant for the manufacture of reinforced plastics products. The plant includes facilities for mold making, research and product development, and custom molding.

Witco Chemical Co., 260 Madison Ave., New York 16, N. Y., has opened a sales office at 1447 Peachtree St., Atlanta, Ga., to serve markets for the company's products in the Southeast. **Clement Damen,** who has been affiliated with the **Witco Sales Dept.** since 1924 and recently has been in charge of the Washington office, will supervise the new office.

The Atlanta office, while serving all industries, will concentrate on manufacturers of plastics, rubber, paint, and grease. Stocks of Witco stearates, carbon blacks, paint driers, vinyl stabilizers and plasticizers, rubber chemicals, and gelling agents will be maintained in the southern district.

The company also announces that **Thomas F. Callahan** has been transferred from the New York office to the sales office at 616 St. Clair Ave., N. E., Cleveland, Ohio. **James E. Cunningham** is now on the New York sales staff. He joined Witco as a laboratory technician in 1944 and subsequently became manager of the Brooklyn, N. Y., stearates plant. In 1951, he was named a member of the technical service staff.

Monsanto Chemical Co.'s Plastics Div., Springfield, Mass., announces that **John A. Sherred,** formerly in charge of development functions in the Research Dept. of Monsanto's Texas City, Texas, plant, has been named director of research development of the Plastics Div. at the St. Louis office.

Naugatuck Chemical Div., United States Rubber Co., reports that its New York sales office has moved to the company's headquarters at 1230 Avenue of the Americas.

W. L. Stensgaard & Associates, Inc., 346 W. Justine Ave, Chicago 7, Ill., announces that **Dane Hahn** has been elected vice president of the company. Mr Hahn is manager of the Eastern division with headquarters at Stensgaard's New York office in the RCA Bldg. **John Govanus** has joined the organization in Chicago as graphic arts production manager.

H. I. Thompson Fiber Glass Co., 1526 W. 166th St., Gardena, Calif., reports that **Brandt Goldsworthy** has been elected vice president of its newly acquired plastics division. The new division will continue to operate under the name of **Industrial Plastics Co.** as a division of the parent company.

Celluplastic Corp., 50 Avenue L, Newark 5, N. J., has named **Bowen & Co.,** 2127 N. Meridian St., Indianapolis, Ind., as its representative for the state of Indiana. Celluplastic produces Clearsite transparent plastics containers for industry,

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STABILIZERS *WITCO Stabilizer #90*—non-toxic. For food-wrapping film. *WITCO Stabilizer #80*—cadmium-barium type liquid, efficient under dynamic heat conditions. Valuable in plastisols, organosols. *WITCO Stabilizer #70*—unusual heat stability, good lubricity. *Lead Stearate #30*—for non-transparent vinyls—electrical grade for insulation. *Lead Stearate #50 (dibasic)*—for opaque goods. High lead content. *Cadmium Stearate*—for transparent formulations. *Barium Stearate*—for color-stable items which come in contact with sulphur fumes. *Calcium Stearate*—non-toxic. Used in vinyl films for foodstuffs.

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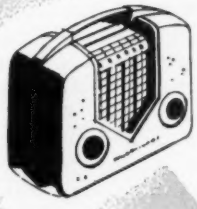

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Corona Mfg., 5210 San Fernando Rd., Glendale 3, Calif., infra-red industrial oven manufacturer, announces that under agreement with **Merco Industries**, Seattle, Wash., Corona will have exclusive license under Merco's patent for the Merco Infra Pyrex tube heater in the industrial oven field. Plans are under way to consolidate Merco regional distributors and institute an extensive sales promotion program. **J. E. Blaine**, former executive director of procurement for **Lockheed Aircraft Corp.**, is president of Corona.

Consoweld Corp., Wisconsin Rapids, Wis., announces the election of the following officers: **Stanton W. Mead**, president; **Ralph R. Cole**, vice president; and **Thomas A. Duda**, secretary and treasurer.

At the same time, **John A. Davies** has been appointed general sales manager and **Jay G. Somers**, general manager of the new Consoweld plastics plant under construction. Mr. Davies entered the plastics laminate industry as sales manager of The Arborite Co. Ltd., Montreal, Canada, in 1945. Mr. Somers entered the plastics field in 1940 with American Brakeshoe & Foundry Co., Detroit, Mich., and joined the plastics division of Consolidated Water Power & Paper Co. in 1943 as impregnating and laminating specialist.

Consoweld was formed as a result of an agreement reached last August between Consolidated Water Power & Paper Co. and The Arborite Co. Ltd. for the creation of the new company and construction of the Consoweld plastics laminate plant, comprising 110,000 sq. ft. of floor space.

The City Auto Stamping Co., Toledo, Ohio, has elected **William D. Hahn**, former treasurer, president both of the company and of its subsidiary, **The City Machine & Tool Co.**

As part of its expansion program, the company entered the fibrous glass reinforced plastics field two years ago, with pilot plant operations. City Auto is currently custom molding plastics parts for the automotive, home appliance, and furniture industries.

Plas-Tube Corp., 26 Fahey St., Springdale, Conn., is a new organization established to extrude plastics tubing for containers used to package such items as tacks, screws, hairpins, etc. The company will provide its customers with the tubing, plus the top and bottom caps which are punched from extruded strip. At present the company is using butyrate only. It expects, however, to start on acetate soon and is also experimenting with extruded polystyrene tubing. Springdale is a small community near Stamford.

Frank Radlof, Stirling, N. J., has started a unique new business that should be of considerable interest to the plastics industry. He will specialize in repairs and sealing of such items as plastic raincoats, wading pools, inflated toys, and all other items of such nature that may require occasional mending.

Klug Engineering Service, 216 S. Mansfield Ave., Los Angeles 36, Calif., announces the completion of development work on a nylon roving, called Nyrove, which has been designed especially for use in the field of reinforced plastics.

Corrulux Div., Libbey-Owens-Ford Glass Co., announces that **Ralph W. Burdeshaw** has been named general sales manager of the division. His headquarters will be in the Prudential Insurance Bldg., 1100 Holcombe Blvd., Houston, Texas. **Peter W. Fisher**, sales manager for the southwestern region in Houston, has been appointed assistant sales manager and will also retain his regional duties.

PERSONAL

Sidney R. Smith, who helped pioneer the use of a **Du Pont** plastic in automobile safety glass, was honored at a dinner at Hotel Du Pont on the eve of his retirement, after 37 years with the company. The dinner was attended by officials of Du Pont's Polychemicals Dept. and representatives of some of the major glass companies who worked with Mr. Smith on the use of Butacite polyvinyl butyral resin as the nonshattering plastic interlayer for safety glass.

A retirement gift and testimonial scroll were presented to Mr. Smith by **Arnold E. Pitcher**, retired general manager of the former Plastics Dept. of Du Pont.

Henry Avery has been appointed manager of **Pittsburgh Coke & Chemical Co.'s Coal Chemicals Div.**, Pittsburgh, Pa. He replaces Alan S. Evans, who has resigned to join The Neville Chemical Co. as vice president in charge of sales. Mr. Avery joined the company in 1951 as manager of the **Plasticizer Div.**, which post he will retain in addition to his new responsibilities.

Howard A. Acheson, Jr. has joined the staff of **Acheson Industries, Inc.** as assistant to **Raymond Szymanowitz**, executive vice president. Mr. Acheson will be located in the company's Newark, N J., office.

William R. Browne has been named a New York sales representative of **Fiber Glass Div., Libby-Owens-Ford Glass Co.** He will report to **Thomas L. Carver**, New York district manager, at 570 Lexington Ave.

Raymond Paul Wiedbusch has joined **Koch Mfg. Co.**, 319 W. Main St., Jackson, Mo., as plant superintendent and production manager. Mr. Wiedbusch's former affiliations were with Gerber Plastic Co., St. Louis, Mo., and Cinch Mfg. Co., Chicago, Ill. He joined Gerber as plant superintendent and was responsible for the development of several plastics items.

Dr. Walter J. Reppe, vice president and director of **I. G. Farbenindustrie A. G.** since 1939, will arrive in the United States in October for a six-week stay, during which time he will lecture at Carnegie Institute of Technology, Pittsburgh 13, Pa., and at several other important chemical centers. He will be a visiting Professor of Chemistry at Carnegie Institute under a grant from **Koppers Co., Inc.**, Pittsburgh 19, Pa.

Dr. Reppe's experiments with acetylene under pressure have come to be known as "Reppe Chemistry." His methods of processing acetylene

led him to explore a number of syntheses, which make possible the production of a large number of new compounds.

Jack E. Bolt has been named application engineer in the Phenolics Engineering Unit, Chemical Materials Dept. of **General Electric Co.'s Chemical Div.**, Pittsfield, Mass.

James W. Hendry, designer of plastics molding presses, has been promoted to vice president of **Jackson & Church Co., Saginaw, Mich.**

Mitchell A. Kapland has joined **The Englander Co., Inc.** as vice president of its **Plastics Div.** located at 227 Warwick Ave., Baltimore, Md. Mr. Kapland will be filling a newly created job. He will be in charge of sales, administration, and manufacture of reinforced plastics.

Gerald Reinsmith is now factory manager of **Narmco Metlbond Co.**, 504 S. Central Ave., Chino, Calif., manufacturer of Multiwave formable aluminum core and fabricators of bonded metal parts. Mr. Reinsmith was formerly office manager of **Narmco Industries**, Washington, D. C.

Ken Hanks has joined **Laminated Plas-Tex Corp.**, 1427 W. North St., Springfield, Ohio, as Western divisional sales manager. Mr. Hanks was formerly associated with Polyplastex United, Inc.

Leonard Cole has been appointed advertising manager of **Barclay Mfg. Co.**, 385 Gerard Ave., New York 51, N. Y. The company manufactures plastic-coated tempered Masonite panels, fibrous glass panels, and other building supplies.

Kenneth M. Irey has been elected assistant vice president of **Heyden Chemical Corp.**, 342 Madison Ave., New York 17, N. Y. Mr. Irey joined the company in 1949 as assistant manager of the company's Garfield, N. J., plant and subsequently became chemical production manager. From 1939 to 1949, he was plant superintendent of Monsanto Chemical Co.'s plastics plant, Springfield, Mass.

William Poliner has joined **Popular Plastic Products Corp.**, Northport, N. Y., as industrial sales engineer. He will assume responsibility for the enlarged plastics packaging program which has been undertaken by the company. Mr. Poliner was formerly chief of the Molded Plastics & Film Section, Containers & Packaging Div. of the National Production Authority, Washington, D.C.

William Murphy has joined **Bolta Corp.**, Lawrence, Mass., as assistant production manager.

Charles F. Rout has been appointed to the sales staff of **S & W Molding Co.**, Columbus, Ohio. His former affiliations were with North American Aviation, Inc., Columbus, Ohio, as an analyst and J. C. Penney Co., Michigan City, Ind., as a department manager.

John Conway has joined **Hatco Chemical Co.**, King George Post Rd., Fords, N. J., as sales manager. Mr. Conway has been with Carbide & Carbon Chemicals Co. for 18 years.

Ralph W. Lotz has been named vice president and chief engineer of **Plastics Products Corp.**, P. O. Box 857, Cleveland, Ohio. Mr. Lotz was formerly connected with Reinforced Plastic Div., Apex Electric & Mfg. Co.

John E. Byrider, formerly with The General Tire & Rubber Co., Akron, Ohio, is now a manufacturer's representative for the sale of General's extruded vinyl film. He leaves his position as sales manager of General's Plastics Film Div. after 15 years to form his own organization to be known as **Bylon Products Co.**, Greensburg, Pa.

Mrs. Ruth Millard, formerly public relations director of Toy Manufacturers of the U. S. A. and American Toy Institute, has been named public relations consultant of **Toy Guidance Council, Inc.**, 1124 Broadway, New York 10, N. Y. Mrs Millard will aid in the Council's new $1,300,000 program to stimulate year-round toy sales and advise parents in the selection of proper play tools. Mrs. Millard opened her own offices to be known as **Ruth Millard & Associates**, 50 E. 42nd St., New York, N. Y.

Edward W. Smith III has been appointed New York district sales manager of **Bradley Container Corp.**, Maynard, Mass., producer of polyethylene collapsible tubes and squeeze bottles. Associated with Celanese Corp. of America since 1944, Mr. Smith recently resigned as director of sale of the Polyester Resin Dept. a post he had held since October 1953. He served with the National Production Authority as chief of the Polymer Section, Plastics Branch, Chemical Div., from Feb. 1951 to March 1952. Mr. Smith's headquarters will be at 8 Peter Cooper Rd., New York 10, N. Y.

MEETINGS

July 12-16—National Housewares Manufacturers Assn., Twenty-first National Housewares Exhibit, Auditorium, Atlantic City, N. J.

August 1-4—Western Merchandise Exhibitors Assn., Twenty-ninth Western China, Glass, Gift, Jewelry, Stationery, and Housewares Show, Civic Auditorium, Palace, St. Francis, and Sir Francis Drake Hotels, San Francisco, Calif.

August 15-18—Western Merchandise Exhibitors Assn., Pacific Northwest China, Glass, Gift, Stationery, Jewelry, Toy, and Housewares Show, Civic Auditorium, Olympic and New Washington Hotels, and Terminal Sales Bldg., Seattle, Wash.

August 17-19—Western Packaging & Materials Handling Exposition, Civic Auditorium, San Francisco, Calif.

August 22-25—Western Merchandise Exhibitors Assn., Portland China, Glass, Gift, Jewelry, Stationery, Toy, and Housewares Show, Public Auditorium, Plaza and Benson Hotels, Portland, Ore.

August 29-31—Western Merchandise Exhibitors Assn., Gift Show, Davenport Hotel, Spokane, Wash.

Sept. 12-16—American Institute of Chemical Engineers, Meeting, Hotel Colorado, Glenwood Springs, Colo.

Sept. 21-23—Society for Experimental Stress Analysis, Annual Meeting and Exhibition in Conjuntion with First International Instrument Congress and Exposition, Bellevue-Stratford Hotel, Philadelphia, Pa.

Sept. 23-26—Packaging Machinery Manufacturers Institute, Twenty-second Annual Meeting, Grove Park Inn, Asheville, N. C.

Oct. 26—Association of Consulting Chemists and Chemical Engineers, Inc., Annual Symposium and Banquet, Hotel Belmont Plaza, New York, N. Y.

CLASSIFIED ADVERTISEMENTS

MODERN PLASTICS reserves the right to accept, reject or censor classified copy.

EMPLOYMENT • BUSINESS OPPORTUNITIES • EQUIPMENT (used or resale only)

MACHINERY and EQUIPMENT FOR SALE

HYDRAULIC PRESSES: 1—Erie Belt Press, 4242 Tons, 2—8" openings, 18'-0" x 52" Steel Steam Platens, 6 rams—30" dia. x 16" stroke. 1—Birdsboro, 2000 Tons, down-acting ram 34" dia. x 14" stroke, 48" DLO, 42" x 42" bed area. 1—Clearing, 500/1500 Tons, completely self-contained with controls for manual or automatic operation, suitable for compression and injection molding. 1—Farrel, 393 Tons, 48" x 48" steam platens, 2—15" openings, 4 rams 10" dia. x 24" stroke, approx. 15" per opening. 1—Baldwin-Southwark, 300 Tons, Slab-side, 30" x 30" Steel Steam Platens, 21" DLO, Ram 20" x 15" Stroke. 1—Baldwin-Southwark, 200 Tons, 3-Opening, 20" x 20" Steel Steam Platens, Ram 12" x 20" Stroke, 3500 PSI. 1—Southwark, 200 Tons, 2-Opening, 30" x 30" Steel Steam Platens, Ram 14" x 14" Stroke. 1—Thropp, 150 Tons, 36" x 36" Steel Steam Platens, 15" DLO, Ram 14" x 12" Stroke. 1—Watson-Stillman, 100 Tons, down-acting ram 11½" x 9½" x 6" stroke, 22" x 20" bed, 24" DLO, self-contained, 15 HP MD Vickers Pump. Unit PRACTICALLY NEW. 1—Watson-Stillman, 100 Tons, 11¾" x 12" platens, 22½" DLO, ram—8" dia. x 15" stroke, complete with 3 HP MD Pump. 1—HPM, 100 Tons, 18" x 18" platen area, ram—8" dia. x 18" stroke, 30" DLO, Steel Cylinder—4000 PSI. 2—Burroughs, 75 Tons, down-acting, 17½" x 17" electric-heated platens, 13½" DLO, ram—8" dia. x 10" stroke, complete with 7½ HP MD Oilgear Pump. 1—HPM, 35 Tons, down-acting ram 6" dia. x 6" stroke, 15" DLO, 12" x 6" bed area, self-contained. 1—Induscо Laboratory Press, 12 Tons, Hand Operated, 8" x 8" electrically heated platens. NEW. INJECTION MOLDING MACHINES: 1—Plasticor Vertical 2 oz., Electric Heated, Hand Operated. 1—HPM Horizontal Model 54, 2 oz., 22 Ton Clamp, 12 Ton Injection, Manual Control, Oil Heated. 2—HPM Model 200-H, 9 oz., 200 Ton Clamp, 31 Ton Injection, Electrically Heated, Full Controls, Excellent Condition, in operation. 2—Impco Model VF-822A, 22 oz., 350 Ton Clamp, 100 Ton Injection, Electrically Heated, Full Controls, Excellent Condition. In operation. Also: Plastics & Rubber Extruders, Mills, Mixers, Grinders, Injection Molding Machines, Pumps, Valves, Platens, etc. JOHNSON MACHINERY COMPANY, 683-P Frelinghuysen Avenue, Newark 5, New Jersey. Tel.: BIgelow 8-2500. What have you for sale? What are you looking for?

FOR SALE: 1—F.B. 32"x92" inverted-L4 Roll Calender, red. drive, d.c. vari-speed motor; 1—National Erie 8"x24" 2 Roll Mill, 10 HP motor; 1—S. B. 8"x16" 3 Roll Calender, 20 HP motor. 2—Hydraulic Presses, 7 heated platens—1—French 42"x42", 20" dia. ram, 1—Southwark 48"x48", 4—12" dia. rams; 75 HP motor; 2—Colton 5½T Preform Presses; 1—Royle No. 4 Extruder, M.D.; 1—6"x12" Lab. Roller Mill; 1—Reed-Prentice 4 oz. Model 10A Injection Molding Machine; 1—No. 1 Banbury Mixer; 7—Dry Mixing Blenders up to 5,000 lbs.; 3—Micro Pulverizers; 1—Ball & Jewell Cutter #2, 15HP motor; 1—Kux Model 50 Preform Machine. Also Grinders, Extruders, Pulverizers, Baker Perkins Mixers, Screens, Kettles, etc. Send us your inquiries. We buy your idle machinery. CONSOLIDATED PRODUCTS CO., INC., 50 Bloomfield Street, Hoboken, N.J. HOboken 3-4425. N. Y. Tel.: BArclay 7-0600.

FOR SALE: Injection Presses: 4, 8, 16 & 22 oz. Reeds, 4, 9, 16 oz. HPM, 15 oz. Crown Moldmaster, 3 oz. Moslo, 1 oz. VanDorn. Scrapgrinders, Ovens. Compression & Transfer presses: 50, 100, 250 tons. Stokes Automatic 50 tons 235 A, Stokes Standard Transfer 258. Preform presses. 42" Slitting & Rewind machine, 3 HP Gasboilers. McBeth Daylite Testbooth, Equipment to be inspected in operation. List your surplus equipment with me. JUSTIN ZENNER, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: Stainless Steel Rotary Dryer. Link Belt Co., 5'2"x16', No. 502-16, with all auxiliary equipment. Roto Louvre type. Reply Box 1903, Modern Plastics.

AVAILABLE AT BARGAIN PRICES
Colton 2RP and 3RP 10-35 Rotary &#5½ Tablet Machines. Rotex, Tyler Hum-mer, Selectro, Robinson, Raymond, Gayco, Great Western Sifters. Mikro Bantam, 1SH, 2TH, 3W, 4TH Pulverizers; Schutz O'Neill Mills. Baker Perkins Heavy Duty Steam Jacketed, Double Arm, from 12 to 200 gal., Mixers (Unidor and Vacuum also). J. H. Day, from ¾ up to 100 gal., Imperial and Cincinnatus D. A. Jacketed, Sigma Blade Mixers. Day, Robinson, Munson Dry Powder Mixers, 15 to 10,000 lbs., all sizes. F. J. Stokes RBB Rotary and R Tablet Machines. Package Machy. FA, FA4, Miller, Hayssen, Scandia, Oliver Auto. Wrappers. REBUILT AND GUARANTEED—This is only a partial list. Over 5000 machines in stock—available for immediate delivery. Tell us your machinery requirements. UNION STANDARD EQUIPMENT CO. 318-322 Lafayette St., New York 12, N. Y.

SAVE WITH GUARANTEED REBUILT EQUIPMENT: Hydraulic Presses: 2 new R.D. Wood 500 ton 54"x26" platen, 42"x37", 20" ram, 475 tons; 2-7 opening 27"x27", 18" ram, 565 tons; 24"x24" 12" ram, 170 tons; 24"x20" 10" ram, 118 tons; 20"x20" 10" ram, 118 tons; 20"x20" 10" ram, 200 tons; 30"x20" 8" ram, 75 tons; 24"x20" 8" ram, 75 tons; 14"x14" 8" ram, 75 tons; 15"x15" 8" ram, 75 tons; 2-19"x24" 10" rams, 78 tons; 12"x12" 6½" ram, 50 tons; 14"x14" 8" ram, 50 tons; 8" x 9½" 4½" ram, 20 tons; 16"x16" 3½" rams, 12 tons; PREFORM PRESS: Colton 5½T, Reeves Drive and Motor; LABORATORY PRESSES: Carver & Watson Stillman Units; NEW UNIVERSAL DUAL PUMPING UNITS: 3-15 HP; NEW LABORATORY MILLS, and CALENDERS; EXTRUDER; Modern Plastic 1½"; ACCUMULATOR; HPM 6" ram 2500#, also Mixers, Vulcanizers, Injection Molding Machines, etc. UNIVERSAL HYDRAULIC MACHINERY CO. INC., 285 Hudson Street, New York 13, N. Y.

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(5) NEW WATSON-STILLMAN EJECTION Molding Heating Chambers, one four ounce, one six ounce, two eight ounce, one sixteen ounce. Price one third the cost of new. New 75 ton presses, size 22x22, 10" ram, 10" stroke, $1100 each, ten day delivery f.o.b. Brooklyn, New York, one or more can be obtained. HYDRAULIC SAL-PRESS CO., INC., 388 Warren Street, Bklyn., N.Y.

INJECTION MOLDING MACHINE—6 oz. Excellent condition. Complete and ready for operation. Low priced for immediate sale. $2500.00. Includes all instruments, two ounce additional fluted cylinder, heating bands, etc. Ideal for plastic mold makers. Vicker's 1000 pound pressure pump. 7½ H.P. motor. Phone for appointment. ESSEX 3-1739, Irvington, N. J.

36"x72" THOMPSON SURFACE GRINDER built in May 1951. New condition. Complete with chuck, coolant system and large supply of new grinding wheels. Present replacement cost $44,000.00. Our price $33,000.00. FAIRFIELD EQUIPMENT CO., 70 Sanford St., Fairfield, Conn. Phone: Fairfield Clearwater 9-3321.

FOR SALE: 1—3¼" Harteg Extruder, fully equipped, 1—4½" Harteg, 1—HPM-12 oz. Injection Molding press, 1—Brosites 10 tray oven, 1—B&J small Granulator, 1—NRM-6"x11' take off conveyor. All equipment in good condition. THE CORSON RUBBER PRODUCTS, INC., Plastics Division, 775 Wooster Rd. N., Barberton, Ohio.

FOR SALE: Leominster 8 oz. Injection Molding Machine complete late type. Plastic and Rubber Equipment. Farrel 16"x48", 15"x36" and 6"x12". 2 roll mills. Farrel 84" 4 roll Calender. Mills and Calenders up to 84". New Seco 6"x12" and 6"x16" Lab. Mixing Mills and Calenders. Rubber & Plastic Extruders. Stokes #280, 4" diam. Preform Machine. HPM 200 ton 30"x54" Platens. 350 ton 22"x24". New Loomis 340 ton, 24"x56" platens. Southwark 325 ton, 42"x24" platens. 200 ton Brunswick 21"x21" Platens, 14" Ram Record Presses. 100 ton 24"x24". Elmes 75 ton 30"x36". Also presses Lab. to 2000 tons from 12"x12" to 48"x48". Hydr. Oil Pumps. Gould 75 HP motor Dr. 2 stage Centrif. Pump 250# W.P. W.S. 4 Plgr. High and Low Pressure Hydr. Pump. HPM 5 GPM 2700 lbs. Elmes Hor. 4 Plgr. 4500 lbs. and 5500 lbs. Hydr. Accumulators. Stokes Automatic Molding Presses. Rotary & Single Punch Preform Tablet Machine ½" to 4". Injection Molding Machines 1 oz. to 32 oz. Baker Perkins Jacketed Mixers 100, 50, and 9 gal. Plastic Grinders. Heavy duty mixers, grinders, pulverizers, gas boilers, etc. Partial listing. We buy your surplus machinery. STEIN EQUIPMENT CO., 107-8th Street, Brooklyn 15, N.Y. STerling 8-1944.

HYDRAULIC PRESSES rebuilt, repaired. Used presses from laboratory to 1000 tons standard and special, molding and hobbing presses, etc. Used pumping units up to 10,000 p.s.i. all capacities. CLIFTON HYDRAULIC PRESS CO., 291 Alwood Rd. P.O. Box 325, Clifton, New Jersey.

FOR SALE: 3 Colton 5½T preform presses 3" max. dia. 1—1200# stainless steel jacketed ribbon blender, MD. 2 Ball & Jewell rotary cutters, one and five Horsepower. 1—10"x20" plastic mill, M.D. Also molding presses, cutters, mixers, etc. CHEMICAL & PROCESS MACHINERY CORP., 146-148 Grand Street, N.Y.C. Tel.: WOrth 6-3430.

FOUR 200 TONS ELMES HYDRAULIC PRESSES operated at 3000 lbs. with 27½"x26" Platens and 30" daylight, four 4" tie-rods and with push-back cylinders, just released from Production Line in good condition; also Six 20 and 30 Tons Elmes Presses with 14"x10" Platens. Prices are favorable. Reply Box 1910, Modern Plastics.

FOR SALE: MOSLO HC-75 ¾ ounce Plastic Moulding Machine in Excellent working order. Ideal for production of small articles. Includes extra Heater assembly 110 volts with spreader two sets of dies 220-440 3 phase Motor and Starter $1150 value for $950. FACIAL PROSTHETIC LABORATORY, Box 143, Oak Hill, W. Va.

FOR SALE: Embossing Machine for plastic film, light or heavy gauge. Can be used for laminating and polishing. Rolls 60" face with dual let off and dual take up. Equipped with friction clutches, preheating electric controlled. T & M MACHINE & TOOL CO., 29 Greenpoint Avenue, Brooklyn 22, N.Y. Tel.: EV 9-1964.

FOR SALE: Hobbing Press 800 Ton W.S. (2) 300 Ton W.S. Presses 20x20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 9, 8, 4 Oz. Injection Molding Machines. Ball & Jewell Plastic Grinders. Standard Mystic Embossing Presses. Accumulators, Pumps, Valves. AARON MACHINERY CO., INC., 45 Crosby St., New York 12, N. Y. Tel. WOrth 4-8233.

(*Continued on page 198*)

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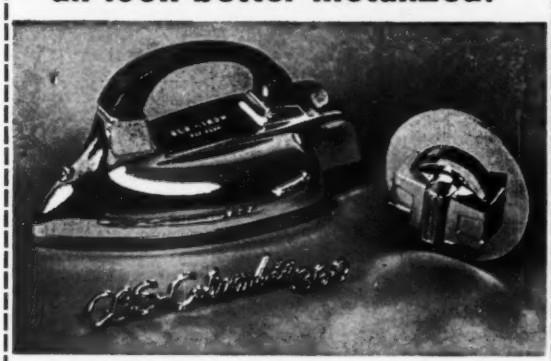

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CLASSIFIED ADVERTISING

(*Continued from page* 196)

KUX MODEL 25 AND STOKES RD3 Rotary Presses; B & J Rotary Cutters #1½ and Standard Ideal; Mikro Pulverizers Bantam, #1-SH, #2-SI, #2-TH; B.P. 50 HP, 50 gal. Sigma Blade Jacketed Mixer; W & P 100 gal. Mixer and 1 qt. and 10 gal. Stainless Steel Mixers. Large stock steel and stainless steel tanks and kettles. PERRY EQUIPMENT CORP., 1429 N. 6th Street, Philadelphia 22, Pa.

FOR SALE: 48 oz. Watson-Stillman, 1952. 16 oz. H.P.M., $11,000. 12 oz. Crown Moldmaster, $10,500. 12 oz. Lester w/16 oz. cylinder. 12 oz. Impco, $8,000. 8 oz. Reed-Prentice, double link, $7,000. 8 oz. Leominster, $5,000. 4 oz. Impco, $8,000. 4 oz. Lester, $3,500. 3 oz. Moslo Minijector. 25 & 50 ton Watson-Stillman angle molding presses, cheap; injection molding machines from 1 ounce to 60 ounces. ACME MACHINERY & MFG. CO., 102 Grove Street, Worcester, Mass.

MACHINERY and EQUIPMENT WANTED

WANTED: Plant or Machinery including Rubber Mills, Hydraulic presses, Sturdy mixers, Calenders, Banbury mixers, Pulverizers, Grinders, Rotary cutters, Extruders, Screens, Injection Molding machines, Dryers. CONSOLIDATED PRODUCTS CO. INC., 50 Bloomfield Street, Hoboken, N.J. HOboken 3-4425. N.Y. Tel.: BArclay 7-0600.

WANTED: Banbury Mixers, Heavy Duty mixers, Calenders, Rubber Rolls & Mixers, Extruders, Grinders & Cutters, Hydraulic Equipment, Rotary and Vacuum Shelf Dryers, Injection Molding Machines. Will consider an operating or shut down plant. P. O. Box 1351, Church Street, New York 8, N. Y.

MATERIALS FOR SALE

INTERESTED IN DISPOSING OF UREA, scrap flash in the following colors: Green, Ivory, Rose and Blue. Also Phenolic of same type material in Brown and Black. Average of 1000 lbs., per week in assorted colors. For information contact: EAGLE ELECTRIC MFG. CO. INC., 23-10 Bridge Plaza S., Long Island City 1, N.Y. Mr. P. Ludwig—ST 4-9200.

MATERIALS WANTED

WANTED: Plexiglas and Lucite scrap, salvage and cut-offs, any quantity. DUKE PLASTICS CORP., 406 Atlantic Ave., Bklyn. 17, N. Y. Ulster 8-9413.

MOLDS FOR SALE

MOLDS FOR SALE—Following molds suitable for 8 oz. machine: 1. Pool table triangle, 2. Novelty cigarette case, 3. Novelty lamp (3 molds), 4. Radio tuning and volume control knob, 5. 8" dresser comb, 6. ½" mouthpiece (for musical toy). All above molds in good condition and will test run before sale. Reply Box 1912, Modern Plastics.

MOLDS FOR SALE
Large capacity water pistol—modern design. 4-cavity mold for outside shells, also 12-cavity mold for inner parts. Will sacrifice for less than ½ cost. Excellent condition. Write:
PRODUCTS RESEARCH, INC.,
171 Newbury Street, Boston 16, Mass.

TOY MOLDS. Two new "Space" Toy Molds, big Sphere Bank and Emergency Kit with flashlight handle. First class condition multiple cavity molds for 16 oz. injection machine (Polystyrene). Available at 30% of cost. For details write to: INTERNATIONAL PLASTICS SERVICE, P.O.B. 1203, Beverly Hills, California, U.S.A.

FOR SALE
First class, top quality comb line, consisting of 12 large Production molds, excellent condition, guaranteed to work. Price less than 1/3 of original cost. Samples and quotation upon request. STERLING PLASTICS CO. Union, N. J.

MOLDS WANTED

BRUSH MOLDS & BRUSH MACHINERY, injection molds for ladies, men's, military, nail, toothbrushes, etc. Send particulars & samples. Box 1000, REALSERVICE, 110 W. 34 St., N.Y.C.

TRAY MOLDS WANTED—Compression molder wants molds to produce household trays or other housewares items. Prefer circular or elliptical tray, not over 16" long. Reply Box 1925, Modern Plastics.

PLANTS FOR SALE

FOR SALE
Complete wood flour mill. Capacity 10 tons per 24 hours, using nearby supply of pine and poplar. For further particulars, reply Box 1902, Modern Plastics.

HELP WANTED

PLASTICS ENGINEER
Chemical Engineer or Chemist for development work in aircraft plastic parts and tooling. Must have experience in reinforced plastics, read blueprints, design parts and tools. Knowledge of polyesters, epoxies, phenolics helpful. The ability to carry assignments through development stage into production is essential. Pleasant working conditions and stimulating atmosphere. Republic is known throughout industry for its liberal benefits and free family-employee hospitalization and insurance provisions. Please forward complete resume to:
Mr. Charles J. Ketson, Employment Mgr.
REPUBLIC AVIATION CORP.
Farmingdale, Long Island, N.Y.

PLASTISOL CHEMIST—Unusual opportunity for man experienced in formulating vinyl plastisols with fast growing aggressive Brooklyn concern. FEDERAL CHEMICALS CORP., 210 Wythe Ave., Brooklyn 11, N.Y.

VINYL COLOR MATCHER
Require man experienced in color matching and production color control in vinyl film and sheeting operation.
Reply Box 1906, Modern Plastics.

TWO OPENINGS—PRODUCT DEVELOPMENT, Technical Service, and Market Research—Require technical graduates with 5-15 years broad experience in application of thermoplastics, including vinyls, for a large chemical company doing research and development, and planning entry into production of plastic materials. One position in New York City (product development and market analysis, leading to sales position at later date); one in deep South (liaison between laboratory research and development program and potential consumers, leading to technical service at later date). All replies held strictly confidential. Write, giving complete resume, to Box 1924, Modern Plastics.

PLASTIC DEVELOPMENT CHEMIST. 35 to 45 years. Thoroughly familiar with formulating and processing phenolic and melamine molding compounds. Must be aggressive and able to take initiative in development of new materials. Midwest manufacturer. Leader in field. Reply giving salary desired, including educational and practical background. Reply Box 1923, Modern Plastics.

ENGINEER for reinforced plastic experimental and production work. Must have thorough knowledge of polyester-fiberglass laminating techniques. Bag and matched tooling experience particularly desirable. Excellent opportunity in an established firm in a southwestern state. Submit resume of experience and salary requirements. Reply Box 1904, Modern Plastics.

RESEARCH CHEMISTS; CHEMICAL ENGINEERS, Mechanical Engineers, Physicists. Progressive Midwest concern, due to its expansion program, has currently available permanent positions for technical graduates with industrial experience. Our employees know of these openings. Your reply, giving personal, educational and work history together with salary expected, will be kept in strict confidence. Reply Box 1909, Modern Plastics.

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Experienced in formulation and production of coated textile fabrics. Excellent opportunity for right man.
Reply Box 1929, Modern Plastics.

SHIFT FOREMEN (2) WANTED for Injection Molding Plant. Must be thoroughly experienced in all phases of injection molding, finishing, assembly, shipping, etc. Must be capable of full responsibility for production, quality, maintenance, and personnel on shift. Excellent opportunity for advancement in a rapidly growing plastics firm. Location Western Pennsylvania. Give complete resume, including references and wages expected. Reply Box 1913, Modern Plastics.

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(*Continued on page* 200)

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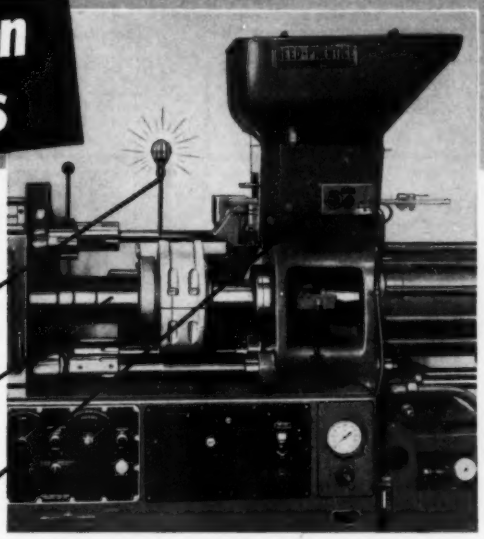

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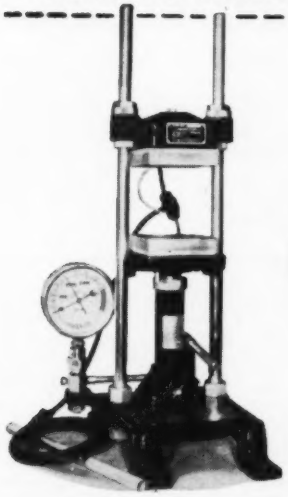

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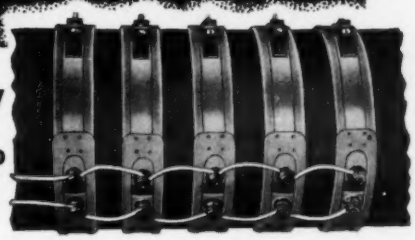

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(*Continued from page 198*)

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Reply Box 1907, Modern Plastics.

PLASTICS PLANT SUPT. Nationally known plastic concern with 20 injection and extrusion machines is seeking topnotch plant superintendent with thoro knowledge of molding techniques, engineering, tool design, finishing, production control and can administer and direct department heads and 250 employees. Excellent future. Sound organization. Mr. Harry Scheer, president, SUPERIOR PLASTICS INC., 426 N. Oakley Blvd., Chicago 12, Illinois.

GRADUATE EE, young, some industrial experience preferred. For development work on printed circuits and solid insulating materials. Graduate ChE's or Chemists, young, with industrial experience for product development work on laminated plastics. Reply Box 1927, Modern Plastics.

PLASTIC CHIEF ENGINEER. Midwest injection molding plant doing Three Million Dollars requires experienced man responsible for estimating mold costs and mold design, production fixtures, customer product development and supervise all engineering functions. Salary commensurate with ability and experience. Unusual opportunity, work with management group. Confidential. Reply Box 1901, Modern Plastics.

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Plastics Division, Springfield 2, Mass.

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OPENING FOR COST ACCOUNTANT with minimum three years factory experience, preferably Plastics, with Los Angeles Molder. Reply by letter giving full details, experience and salary requirements. Reply Box 1932, Modern Plastics.

SALESMAN WANTED. To sell complete line of urea and phenolic resins, and phenolic molding compounds. All correspondence treated in confidence. Reply Box 1914, Modern Plastics.

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Phila., 22, Pa.

PRODUCTION MANAGER—Experienced in plastics compounding, extrusion, Banbury. Excellent opportunity in large Eastern plant. Submit resume including salary requirements. Reply Box 1933, Modern Plastics.

VINYL EXTRUSION FOREMAN, Experienced in color matching, production, quality and personnel, good salary. Reply in confidence to company President. Reply Box 1911, Modern Plastics.

VINYL CHEMICAL ENGINEER
OR CHEMIST
Experienced on heavy or light gauge calendering. Real opportunity with progressive company.
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PLASTIC TECHNICIAN—graduate of the Interstate Training Service. 2½ years experience in all phases of thermoplastic and thermosetting moldings. Desires position with well established firm in Metropolitan New York-New Jersey area. Reply Box 1928, Modern Plastics.

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REPRESENTATIVE WANTED
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CUSTOM MOLDING REPRESENTATIVE: Midwest custom molding company requires representation in Chicago and other midwest areas on commission basis. Reply Box 1919, Modern Plastics.

CUSTOM MOLDING REPRESENTATIVE: Rapidly expanding Chicago area custom injection molder requires representation in: Southern Illinois, Indiana, Ohio, Missouri, Iowa, Minnesota and Wisconsin. Excellent plant cooperation assured. Experienced in supplying all types of completely finished parts. Commission basis. All replies confidential. Reply Box 1926, Modern Plastics.

SALES REPRESENTATIVE wanted by custom compression and plunger transfer molding company. We are interested only in men of proven ability who are now calling on industrial accounts. Modern plant located in Mid-West with modern and up to date facilities. Desirable territories open—commission basis. Reply giving experience, present lines and territory wanted to Box 1917, Modern Plastics.

SALES REPRESENTATION sought by established Chicago custom molder. We are highly competitive and equipped to handle all materials by compression, transfer and injection molding methods. Complete tooling facilities. Full cooperation in sales engineering assistance assured. Commission basis. Replies strictly confidential. Reply Box 1921, Modern Plastics.

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SALES-ENGINEERING REPRESENTATION. Aggressive technical sales representation in California and western areas. Registered Mechanical Engineer with proven Plastics Sales experience. Contacts with Electronic, Aircraft & Missile Industries concentrated here. Formerly Project Engineer major reinforced plastics projects, 14 years aircraft engineering background. Custom molding, products or materials sought. Sales program emphasis based on maximum personal contact. Reply Box 1922, Modern Plastics.

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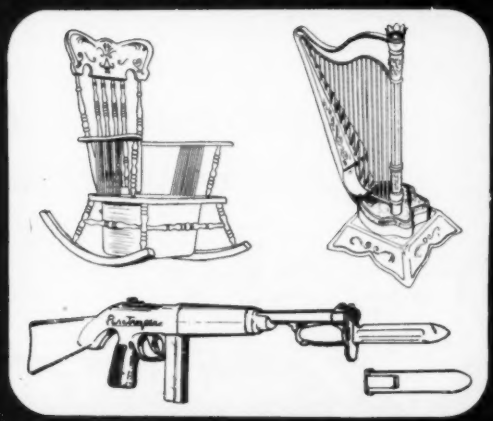

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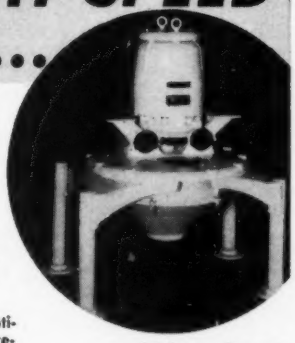

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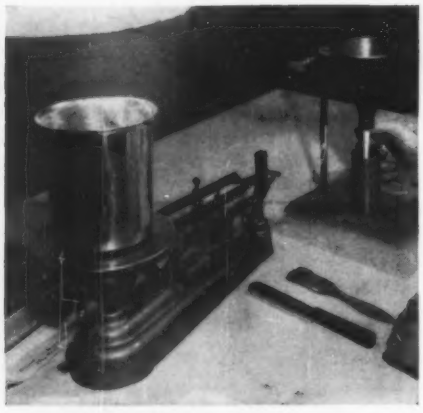

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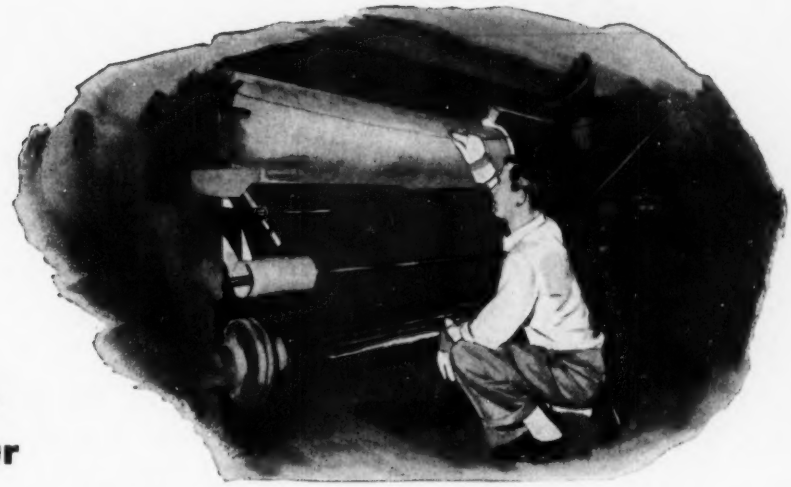

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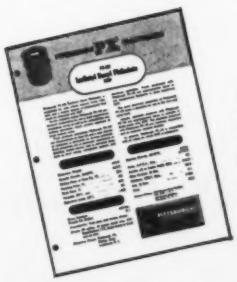

For more information on Pittsburgh PX-118 IsoOctyl Decyl Phthalate, write today for Technical Bulletin No. 118.

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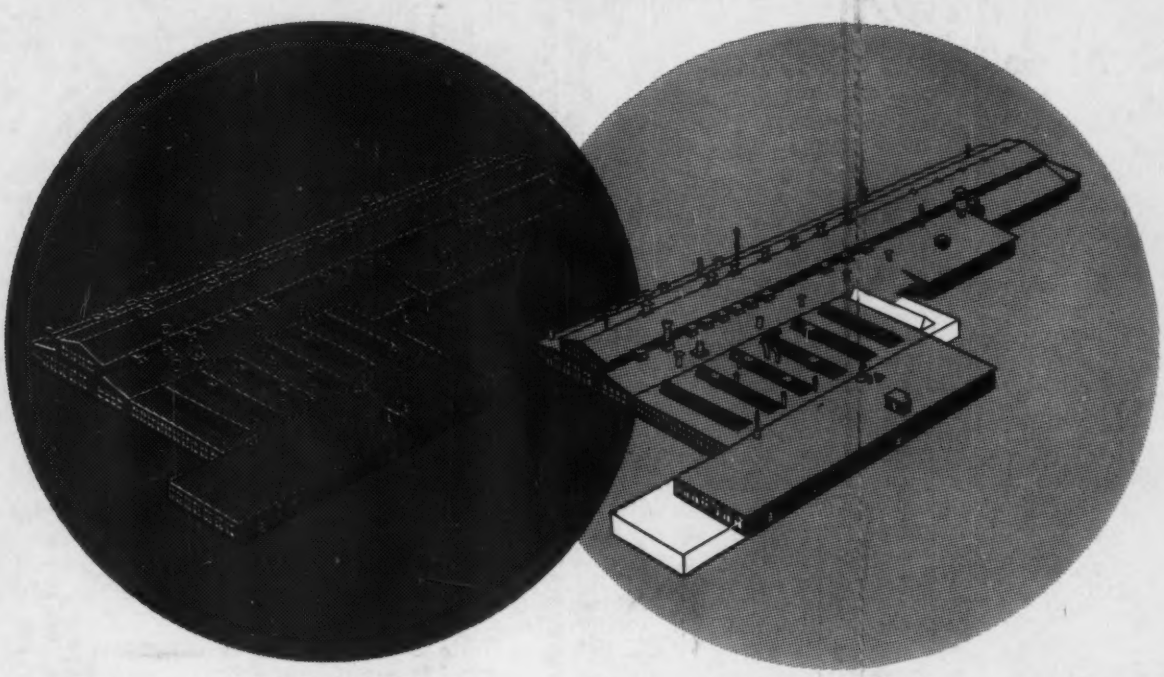

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